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MISDIRECTED PARENTAL CARE BY LEAST FLYCATCHERS AT A WARBLING VIREO NEST

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Some birds use the nests of other birds of the same or a different species for their own breeding attempts. The use of an inactive nest is termed nest re-use, whereas the physical takeover of an active nest is known as nest usurpation.[7,8] In addition to raising their own young in a nest built by another bird, songbirds occasionally have been recorded directing parental care toward the young of another species and this usually involves the feeding of nestlings or fledglings.[11] This behaviour, known as misdirected parental care, differs from brood parasitism wherein a female parasite lays her eggs in the nests of other birds and leaves the care of her offspring to the foster parents. In rare cases, misdirected care may progress to adoption of an unrelated brood, such as a pair of Song Sparrows that gradually took over nearly complete care of a brood of Yellow Warblers.[9] Here, I describe a similar case of misdirected parental care involving a pair of Least Flycatchers at a Warbling Vireo nest that began during the egg stage.

On 20 June 2001, I discovered a vireo nest approximately 7.5 m high in a Manitoba Maple (*Acer negundo*) at Delta Marsh, Manitoba. The small nest was a cup-shaped type that was light-coloured and suspended from the fork of a small branch. No birds were seen near the nest, but a Warbling Vireo sang about 20 m to the north.

Based on past research experience with vireos nesting at Delta Marsh, I was certain this was a Warbling Vireo nest. Of the three species of vireos that have been recorded nesting there, Warbling Vireos are the most abundant, whereas Red-eyed Vireos nest in low numbers and Yellow-throated Vireos are extremely rare nesters in one localized area (personal observations).[12] Neither Red-eyed nor Yellow-throated Vireos were detected in the general vicinity of the nest before or after it was discovered. Two other factors, nest placement and construction, support the identification of this nest as a Warbling Vireo's. At Delta Marsh, Warbling Vireos nest high in the canopy at an average of 8.6 m with 88 % of nests located above 5 m (n = 156 nests), whereas Red-eyed Vireos, on average, nest lower at 4.1 m with 69 % of nests located below 5 m (n = 29 nests; unpublished data). Most Warbling Vireo nests in this area are composed largely of plant down that is covered on the outside with grasses or strips of cattails (*Typha* spp.). Nests composed of these materials appear fairly light in colour. In contrast, Red-eyed Vireos in this area use strips of bark in the outer layer of their nests, which, as a consequence, appear coarser and more brown in colour than Warbling Vireo nests. Because of these differences, the nests of these two species can be reliably separated with experience.

I examined the nest through binoculars the next morning and saw a Least Flycatcher sitting on it. Later that day, the flycatcher was flushed from the nest and the contents were examined with a mirror mounted on

an extendable pole. Much to my surprise, the nest contained four white eggs with dark spots, and not the immaculate white eggs that Least Flycatchers lay. With the help of Spencer Sealy and Robyn Underwood, I climbed to the nest and brought the eggs down for a closer inspection. They were briefly examined and replaced. The eggs were clearly those of a Warbling Vireo. They were white and had characteristic brownish-black spots sparsely covering the egg but concentrated toward the large end. Although not measured, the eggs appeared larger than Least Flycatcher eggs. Average egg measurements are 19.0 x 14.1 mm for Warbling Vireos and 16.8 x 13.0 mm for Least Flycatchers.[1, 5]

I monitored the nest almost daily until 30 June. A single adult flycatcher was observed on the nest at each of these visits. The nest still held all four eggs on 24 June, but when next checked, on 26 June, only nestlings were present. Due to the height and position of the nest, the exact number of nestlings was difficult to determine. A pair of adult Least Flycatchers was observed twice at the nest on 26 June. In the morning, one bird was on the nest and the other was perched 2 m below it. In the afternoon, I observed a flycatcher leaving the nest and another bringing food to the nestlings. On 28 June, the nestlings were begging when the mirror was raised and at least three young were observed. Nestlings were still present on 30 June, but on 5 July the nest was empty. Warbling Vireos fledge about 14 days after hatching,[5] thus, the young could not have fledged in the interim.

I do not know the cause of nest failure. However, an incompatible diet fed to the nestling vireos is an unlikely cause of failure. Although the food provided to nestling Warbling Vireos has not been described,[5] both Least Flycatcher and Warbling Vireo adults at Delta Marsh feed on a similar arthropod diet that consists largely of midges (Diptera: Chironomidae) during the breeding season[10] and Least Flycatchers provide their nestlings with a midge-dominated diet.[1]

Interspecific feeding has been attributed most often to either an individual's nest being close to that of another species or a mixed clutch of eggs resulting from nest usurpation.[11] Least Flycatchers are not known to usurp active nests.[1] However, they occasionally re-use the nests of other Least Flycatchers[2] and there is one record of a failed Yellow Warbler nest being re-used by a Least Flycatcher for a breeding attempt.[6] In addition, there are two records of Least Flycatchers feeding nestlings of other species: one Least Flycatcher fed nestling Chipping Sparrows[3] and another was observed feeding two Brown-headed Cowbird nestlings at a Red-eyed Vireo nest.[4] The close proximity of the Least Flycatcher's nest to the Chipping Sparrow nest was suspected as the cause of interspecific feeding in the first instance.[3,11] A mixed-species pairing was implied as the cause of the behaviour at the Red-eyed Vireo nest,[4] but there was little evidence to support this.

As I did not observe the circumstances that led up to this case of misdirected parental care, I can only speculate as to the potential causes of this behaviour. The flycatchers may have attempted to use this vireo nest for their own breeding effort after usurping the nest or re-using a deserted nest, but either did not lay their own eggs or lost them. An alternative to nest usurpation or re-use is the outright adoption of a deserted vireo clutch by the flycatchers. If this were the case here, I would have suspected not only a nearby Least Flycatcher nest, but one that had recently failed. With Robyn's help, an area of approximately 5 m in diameter around the Warbling Vireo nest site was searched for a Least Flycatcher nest. No active or failed flycatcher nest was found in this area. Unfortunately, there was too little evidence to determine the cause of the misdirected parental care I observed. This observation adds to the previous records of

interspecific feeding in Least Flycatchers, but, to my knowledge, is the first record of Warbling Vireos being involved in any such strange nesting situation.[5, 11]

Acknowledgments

I thank Spencer Sealy and Robyn Underwood for field assistance and commenting on this note. I also thank the Delta Marsh Field Station (University of Manitoba) for providing logistical support. My field work was funded by a grant from the Natural Sciences and Engineering Research Council of Canada to Spencer Sealy.

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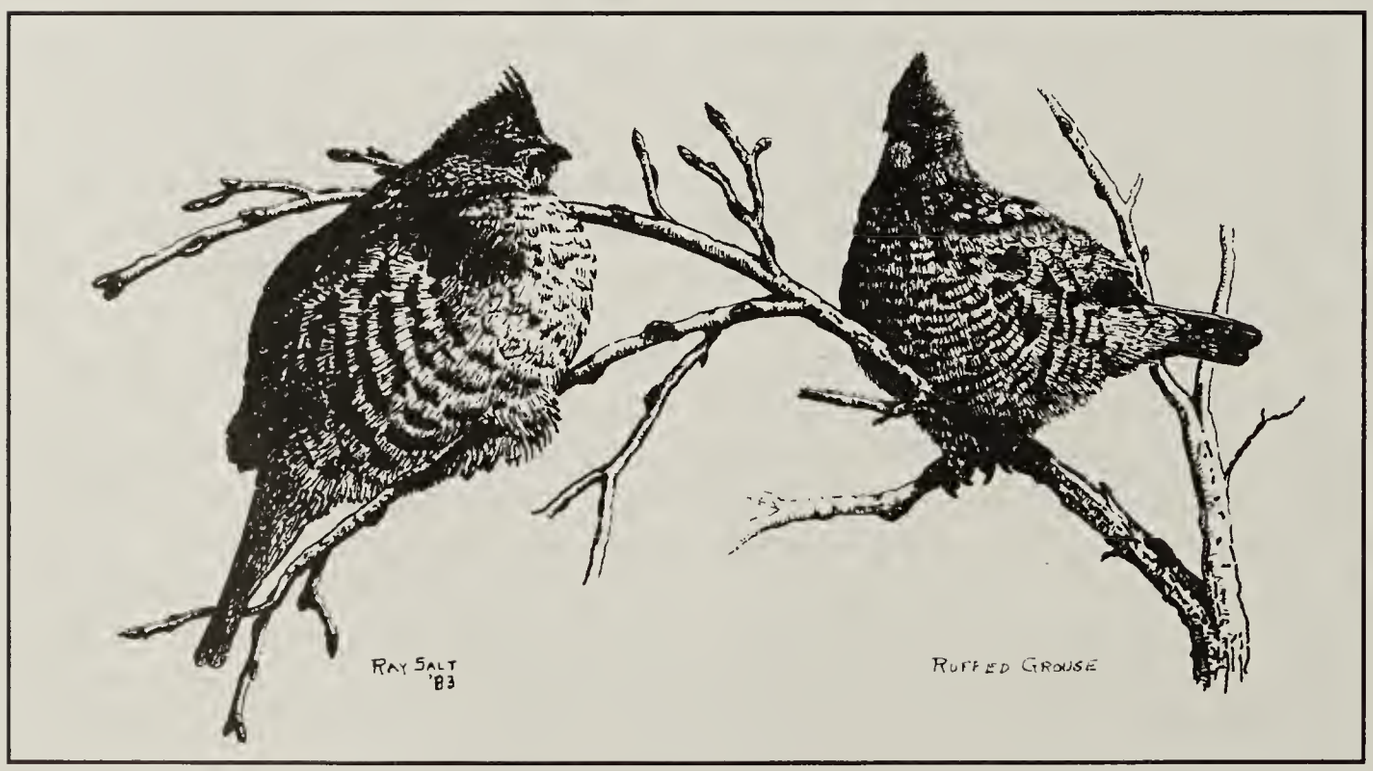

Ruffed Grouse ***W. Ray Salt***

DISTRIBUTION AND ABUNDANCE OF THE COMMON POORWILL IN SOUTHWESTERN SASKATCHEWAN

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Common Poorwill (note transmitter attached to back) ***Mark Brigham***

The Common Poorwill (henceforth poorwill) is one of three species of Caprimulgidae (the Goatsucker family) known to occur in western Canada. The poorwill range includes sw Saskatchewan, se Alberta, and the southern interior of British Columbia.[2] Its Saskatchewan range and abundance are poorly known, but evidence suggests that outside the West Block of the Cypress Hills Interprovincial Park (CHIP), where the species is considered a regular breeder, it is an uncommon and local summer resident in the southwest (Mark Brigham, pers. comm.).[6,9] The first documented breeding record for the province was in 1983 in the West Block of CHIP.[10] A 1991 survey estimated there were 30 territorial males in the West Block region of the park.[6] Territorial poorwills have also been documented in the Great Sand Hills (Don Weidl, pers. comm.) and there are historical records for poorwills from the Frenchman River Valley near Eastend, the most recent being in 1991 (Fig. 1).[4,6] In addition to these areas, poorwills have been documented in and around the West Block of Grasslands National Park (GNP) (Adrian Sturch and Tim Schowalter, pers. comm.).[8]

In 1993, the poorwill was assigned an official status of "indeterminate" in Canada because there was "not enough information on population size or trend to know what the status is."[3] Our objective was to determine the distribution and abundance of the poorwill in Saskatchewan through a comprehensive survey of suitable habitat in southwestern Saskatchewan. This area was chosen because all but one breeding record for poorwills in Saskatchewan occur in the southwestern corner of the province.[9]

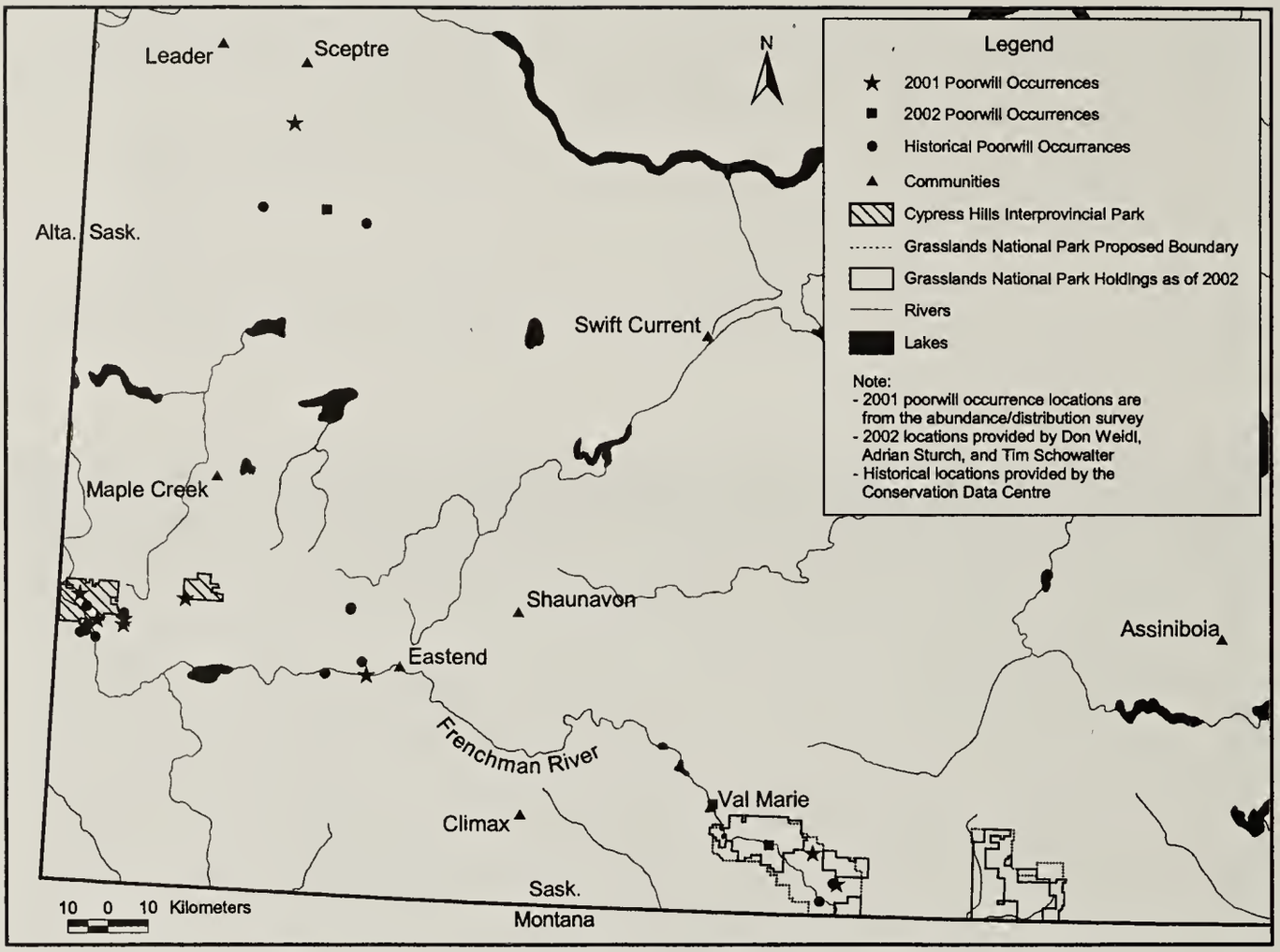

Figure 1. Poorwill occurrence locations in southwest Saskatchewan

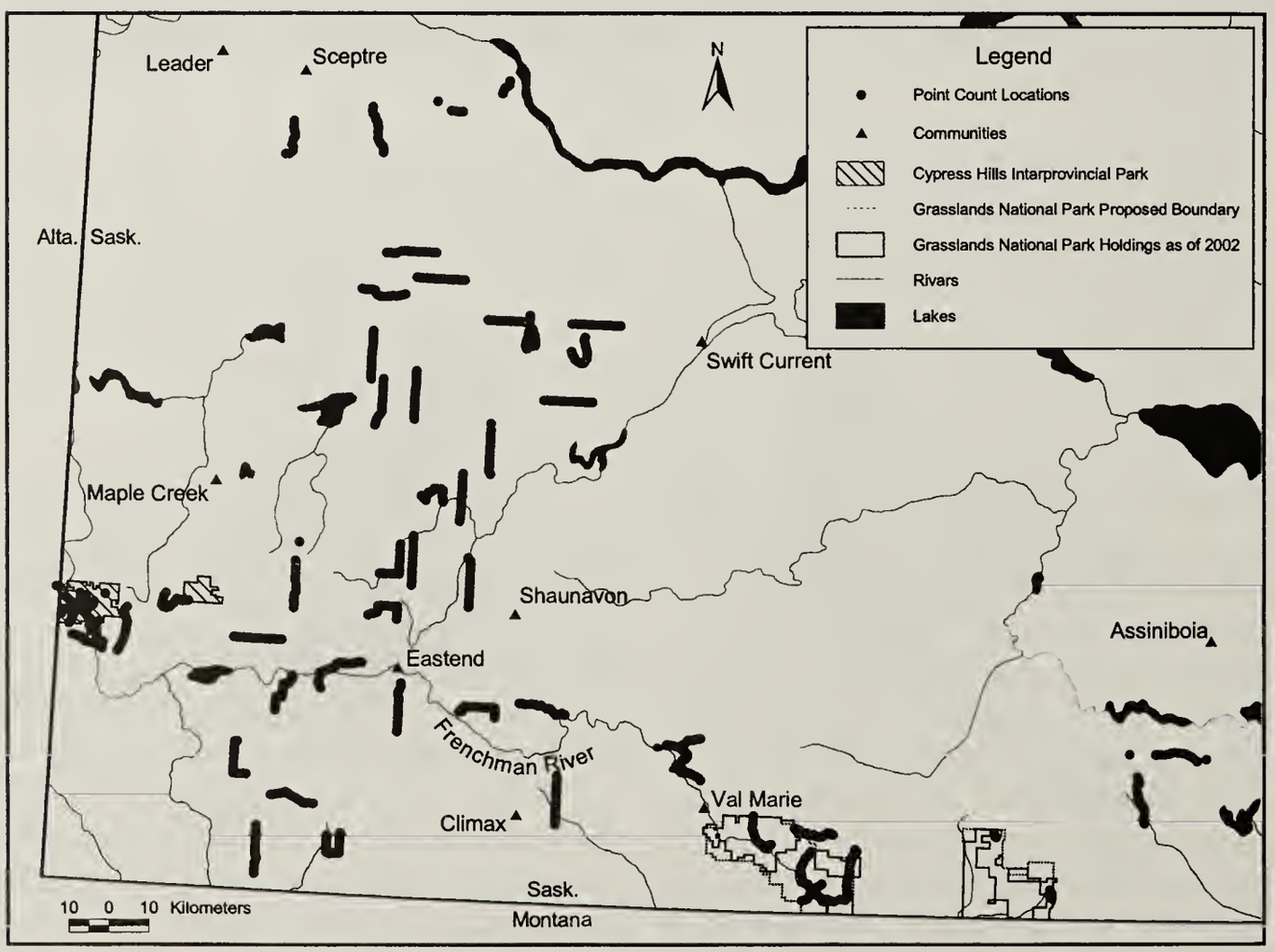

Figure 2. 2001 poorwill survey point count locations

Methods

Using a geographic information system we randomly selected 30 townships (a township is six miles by six miles) in each of National Topographic System mapsheets Prelate (72 K), Cypress Lake (72 F), and Wood Mountain (72 G). Each township consisted of at least 75% grassland habitat (defined as native grassland, seeded pasture, and woody vegetation less than 2 m in height) according to Saskatchewan's Southern Digital Landcover classification. Townships with grassland habitat types were selected because poorwills are not known to occur in cultivated areas (Mark Brigham, pers. comm.). Townships that did not contain gravel or dirt roads were deleted from the sample.

In order to establish starting locations for road-based transects, a point was randomly placed within each of the selected townships. Transects began at the landmark (such as a road intersection or stream-crossing) nearest to each random point that was visible both on the maps and while driving along the road. The starting direction of the transect was chosen randomly relative to the direction of the road. The transect continued in the starting direction as far as possible; if a "T" intersection was encountered, the direction of the turn was chosen randomly. Because road availability is biased toward areas with increased cultivation, we relaxed the selection criterion for transect routing (i.e. disregarded the random start points and directions) after several surveys failed to yield a poorwill. We also supplemented road-based transects with a total of three walking-based transects (each with between 2 and 4 count points - see below) through areas that appeared to be good habitat but had no road access.

The survey was conducted in 2001 between May 23 and July 11, dates that correspond with the early part of the breeding season for the poorwill in Saskatchewan.[2] Kalcounis *et al.* found that poorwill calling in the West Block of CHIP was most intense in late spring and early summer.[6]

A team of two observers conducted all surveys, usually with two transects surveyed simultaneously each night. In order to maximize the amount of area surveyed, each transect was surveyed only once. Poorwills are mainly crepuscular; therefore surveys began 30 min. after sunset and continued for 1.5 hours. Because poorwills are active on nights with bright moonlight, one survey period (July 8) with suitable lunar conditions was extended beyond 1.5 hours. To conduct the point counts for road-based transects, observers stopped every 800 m and exited the vehicle. Point counts for the three walking-based transects were not necessarily separated by 800 m. For all transects, each point count was three minutes in duration. The first minute was designated as a listening period without playback. Playback was started at the end of the first minute and consisted of a series of four or five calls followed by a listening period. This was repeated several times until the end of the three minutes. A Johnny Stewart Electronic Caller was used to broadcast the playback calls. The number of points in road-based transects ranged from 10 to 16, with most having 16.

Results and Discussion

We conducted a total of 757 point counts on 50 transects (including 9 points on 3 walking transects) (Fig. 2). A total of 10 individual poorwills (presumably males) were heard (Figs 1 & 3), 8 of which were detected when they responded to our playback. Poorwills were heard calling both on the wing and from the ground or low perches; one individual was observed sitting on a gravel road, a typical practice for Common Nighthawks, which also reside in the area.[7] Three of the ten poorwills were in, and two were near, the West Block of CHIP (Fig. 3). Two were within the proposed boundary of GNP, on privately leased rangeland (Fig 1). One poorwill was detected in each of the following: Centre

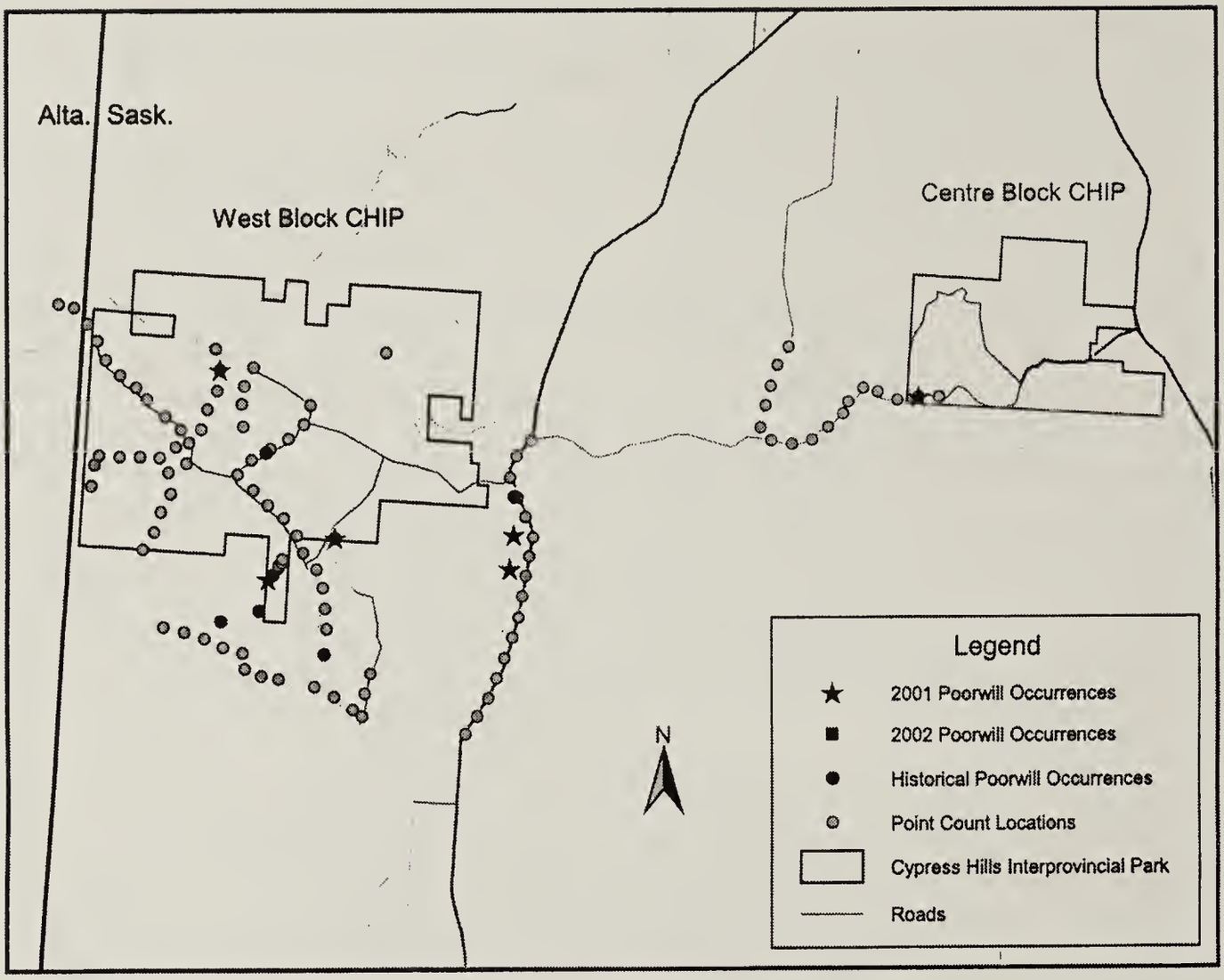

Figure 3. Poorwill occurrence and 2001 survey point count locations for the Cypress Hills in Saskatchewan

Block of CHIP, the Great Sand Hills, and the Frenchman River Valley near Eastend. The poorwill in the Centre Block was the first recorded occurrence for this area.

The poorwills noted in the study appear to be using at least three different landscape types in southwestern Saskatchewan. In the West and Centre Blocks of CHIP, they were found in open native prairie areas near forest edges. The two near GNP were in sloping, sparsely vegetated, native rangeland areas with a high percentage of bare sandy soil. Finally, in the Sandhills, the one individual was found in a shrubby native rangeland area with patches of stunted aspen nearby. However, habitat selection may occur at multiple spatial scales, including landscape and microhabitat levels. Hardy *et al.* found that poorwill habitat suitability was influenced by physiographic features such as dry eroded drainages and sloping uplands as well as microhabitat features such as rocky substrate, mid-canopy vegetation, and an absence of understory grass.[5] Wang and Brigham found that roost sites in the Cypress Hills had "significantly less green vegetation, less overhead cover, more bare ground, and were further away from tall objects than random sites."[11] Our observations are consistent with both of these findings.

Even at close range, all poorwills heard had a two syllable "*poor will*" call, unlike the "*poowJEEwup*" described in most field guides and on most bird call recordings (including the recording we used for playback). Interestingly, one individual, after hearing our playback, added an additional "*up*" syllable to the end of his two-syllable call.

The fact that we detected only 5 poorwills in or near the West Block of CHIP may be a cause for concern. An apparent decline over the last 12 years, noted by biologists conducting other research in the area, is coincident with the termination of logging of Lodgepole Pine (*Pinus contorta*) in the West Block of CHIP. Subsequent regeneration of trees in clear-cuts may be affecting areas that previously provided suitable breeding habitat for poorwills (Mark Brigham, pers. comm.).

Based on historical sightings and the information we collected, it is reasonable to conclude that poorwills have a highly localized breeding distribution in southwestern Saskatchewan. However, it does appear that, at least for the West Block of Cypress Hills, poorwill populations have declined since the early 1990s. Poorwill numbers in areas with suitable habitat should be monitored in the future.

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Typical poorwill habitat in the West Block of Cypress Hills Interprovincial Park
Dave MacDonald

used, and to Jeff Keith (Saskatchewan Conservation Data Centre) who provided historical occurrence location information. Don Weidl (Golder Associates), Adrian Sturch (Fisheries and Oceans Canada) and Tim Schowalter (University of Regina) provided 2002 poorwill location information. Robert Sissons (Parks Canada) provided the GIS file for GNP boundaries. Funding for this project was provided by Environment Canada (Habitat Stewardship Program) and the Saskatchewan Wetland Conservation Corporation.

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SASKATCHEWAN BIRD BANDERS: J.A. BRIGGS OF REGINA*

C. STUART HOUSTON and MARY I. HOUSTON, 863 University Drive, Saskatoon, SK S7J 0J8

When J.A. Briggs applied for a banding permit, his instructions from Ottawa were forwarded to him by Fred Bradshaw, Chief Game Commissioner for Saskatchewan, on April 17, 1925. Briggs was a railwayman who traveled widely along the Canadian National Railway, radiating out from Regina in a hand-pumped "jigger" to inspect the track. Between 1925 and 1943, he banded 1075 birds of 24 species, mainly nestlings, and in 1948 added six more flickers. With the exception of Fred G. Bard, who ranged widely during his crow and magpie campaign, Briggs banded in more localities than any other Saskatchewan bander of his era. Between Regina and Melville, Briggs banded birds at every siding and village: Victoria Plains, Zehner, Frankslake, Edenwold, Avonhurst, Edgeley, Muscow, Fort Qu'Appelle, Hugonard, Balcarres, Gillespie, Lorlie, Finnie, Duff, Colmer, and Melville. Between Regina and Moose Jaw, he banded at Sidmar, Keystown, Stony Beach, Eastview, Burdick, and Moose Jaw,

omitting only the siding of Pattie. He also banded more distantly at Biggar, Millerdale, Frobisher, and Griffin.

Briggs would stop whenever he saw a Brewer's Blackbird nest along the right-of-way or a fresh flicker cavity within human reach in a telephone pole along the track. Thus he banded 147 Brewer's Blackbird nestlings and 324 Yellow-shafted Flickers, together with other cavity nesters such as Purple Martins, Tree Swallows, and House Wrens. In 1934, he caught two adult "Blue Birds" on their nests, one at Avonhurst and one at Edgeley; the Eastern Bluebird was then known in eastern North America simply as "bluebird." As Callin points out, Mountain Bluebirds were then less common than the Eastern Bluebird; they did not become regular until 1937, and became common only about 1950.[1]

Recoveries of birds banded by Briggs include Yellow-shafted Flicker, Brewer's Blackbird, Common Grackle, American Crow, Black-billed Magpie, and Northern Shoveler. Four adult flickers (banded at Zehner, Edenwold, Pasqua and Frankslake) were recaptured at their nest hole one year after banding and one near Avonhurst was recaptured after two years. One banded near Frankslake was shot at Seagoville, Texas, nearly two years later on February 23,[2] and another, banded at Zehner on June 26, 1929, was killed in a storm near Braggs, Oklahoma, on January 25, 1930.

A Brewer's Blackbird banded near Hugonard on June 25, 1930 was found dead near Fort Qu'Appelle on May 19, 1931, and one banded near Lorlie on June 24, 1938, was shot near Lake City, South Dakota on October 11, 1938. A Common Grackle, banded near Avonhurst on June 6, 1932 was shot near Hutchinson, Minnesota on April 19, 1933.

Of seven nestling crows banded in 1927 (five at Biggar and two at Stony Beach), there were three recoveries shot during the year of banding: one a few weeks later near where it was banded, one at Anoka, Nebraska on October 11, and one east of Hutchinson, Kansas on November 13. A crow banded in 1935, one in 1936, and two in 1939, were shot locally, but a third 1939 crow was shot east of Hutchinson, Kansas on 26 February 1941, during its second winter.

Of five young Black-billed Magpies banded at Biggar on 15 July 1939, one was shot locally on New Year's day, while another was shot at Melville, SK as reported in a letter dated 12 November.

From 26 Northern Shovelers banded, Briggs had a remarkable six recoveries: three were shot locally near the banding site the same year and the others were shot during the hunting season of the same year at three locations: Tullymet, Saskatchewan; Hawley, Minnesota; and Big Bend, Louisiana.

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* Number 22 in a series of biographies of Saskatchewan bird banders.

a sord of mallards...

a party of jays....

a congregation of plovers...

an unkindness of ravens...

a host of sparrows.

- James Lipton, *An Exaltation of Larks*, 1991.

BANDING GREAT HORNED OWLS IN FARMLAND IN THE WEYBURN AREA IN 2003

MARTIN BAILEY, 102-1833 Coteau Avenue, Weyburn, SK

Because of time and money restraints, bird banders in Saskatchewan have little opportunity to visit potential nest sites more than once a season to band young. Therefore, they must choose the best weekend to band and, traditionally for Great Horned Owls, that has been the long weekend in May.

Not surprisingly then, when John Whitell first dragged me out on March 29, 2003 to look for Great Horned Owl nests near Weyburn, I had no idea of the numbers of owls that we would see from then to when the last nest site was visited on June 6. Nor did I anticipate that we would go back a minimum of three times to all locations where we had found owls but no nests.

Historically, the area around Weyburn was shortgrass prairie with few if any trees. Today the landscape surrounding Weyburn is dominated by cereal grain and a mixture of native and introduced grasses. Much smaller plots of land containing occupied and abandoned farmyards consist of grasses, Carragana shrubs and planted trees such as spruce, Plains Cottonwood and elm. One bird to take advantage of this habitat has been the Great Horned Owl and it was in the farmyards in the sea of planted grain that we looked for active Great Horned Owl nests.

In an area bounded approximately by N 49° 40' to N 49°15' and W 104.00 to W 104°30' (six townships in size) 19 nests were found. Seventeen were successful. Ten single and two pairs of owls were seen at 12 other locations. Repeated attempts made to find occupied nests in these 12 other locations were unsuccessful.

In one of the two nests that failed, an owlet with its egg tooth still evident was found on the ground below the nest site. The nest had been a resting place for a Fox Squirrel. The nest proved too flimsy for its new residents and its bottom had fallen out. Two cracked eggs were found at the other failed nest site.

All birds at active nests located by Johnnie and myself - as well as by others in the Weyburn area - were banded by Kelly Kozij. Unwittingly, our informal but frequent excursions each week in the Weyburn area and the willingness of Kelly Kozij to band continuously from May 11 until June 6, provided us with a data base that allows us to make a number of tentative conclusions.

The first of these is that the traditional banding weekend for Great Horned Owls in Saskatchewan, the long weekend in May, does fall within the best time to

band owlets in southern Saskatchewan. Kelly estimated the ages of the chicks by plumage and the practical consideration that under two weeks of age Great Horned Owl chicks' legs are too thin to hold a band on them.

Age information became the basis for inferring that the hatching of 90 to 95 percent of all owlets occurred over a three week period beginning April 27 continuing on to May 17. Great Horned Owl incubation lasts between 30 and 37 days, hence it is assumed that sitting on eggs could not have occurred before March 23.[1] It is likely that between March 23 and the end of April, over 90% of all owlets that could be banded will be banded. While Great Horned Owls are known to lay a second clutch if the first is destroyed, this is not a certainty.[3] We had evidence this year that there was only one successful second attempt at laying a second clutch: two owlets that were banded on June 5 at approximately two and half weeks of age. They were the results of a second laying after the first eggs laid at that nesting location were crushed by farm equipment.

While the literature states that single owls are assumed to be immature birds living on the periphery of established territories of breeding pairs, there was no evidence that non-breeders were at a disadvantage in our banding territory.[2] There were no visible differences in either size or habitat between the twelve locations where non-breeders were and the sites where nesting pairs had taken up residence. In this manmade topography, habitat suitable for Great Horned Owls was separated by miles of unsuitable habitat: cereal grain and grasslands vegetation. Breeding and non-breeding birds were, by default, kept apart by man-made barriers.

Were there actually ten different single birds and two different pairs in the locations where they were noticed? Or is it possible that the single birds and the non-nesting pairs could be subjected to double counting? Often a single bird would be found at one location and none would be noticed that day at other sites within five to ten miles. As the literature states, non-breeding owls are neither sedentary nor territorial which would confirm the suspicion that some of the non-breeding birds were being double counted.[1,2] This suspicion was reinforced by Rohner's (1997) work on the territorial behaviour of non-breeding birds in the boreal forests of the Yukon. Rohner concluded that the non-breeding birds ranged over an area that was five times larger than that of breeders. However, this did not mean that 'floaters,' as he calls non-breeders, did not have an affinity for specific territories similar in size to those used by breeding birds.[4]

Were our floaters disadvantaged birds – birds who had not been able to breed for one reason or another? Rohner (1996) found this was the case in times of low numbers of prey species. It was the floaters that had higher mortality rates when food was scarce.[5]

Intuitively this is hard to imagine in the islands of planted trees on grass and grain plains surrounding Weyburn. If anything, non-breeding birds would have more opportunities to pursue game

than breeding birds who must stay close to and defend a nesting site – a nest site not necessarily of the owls' choosing since Great Horned Owls do not make their own nests but occupy what is available. From that site they then seek out prey species for themselves and their owlets. So, while mated birds may be more aggressive than non-breeding birds, they could easily be situated in an island with less food than one that is nearby with no nest sites but more food.

At present this question of non-breeding birds actually being at an advantage to mating pairs will remain beyond the scope of our excursions into man-made Great Horned Owl territory on the open plains. But it is a tantalizing thought suitable for further investigation.

Acknowledgments

Many thanks to the landowners who let us on their land.

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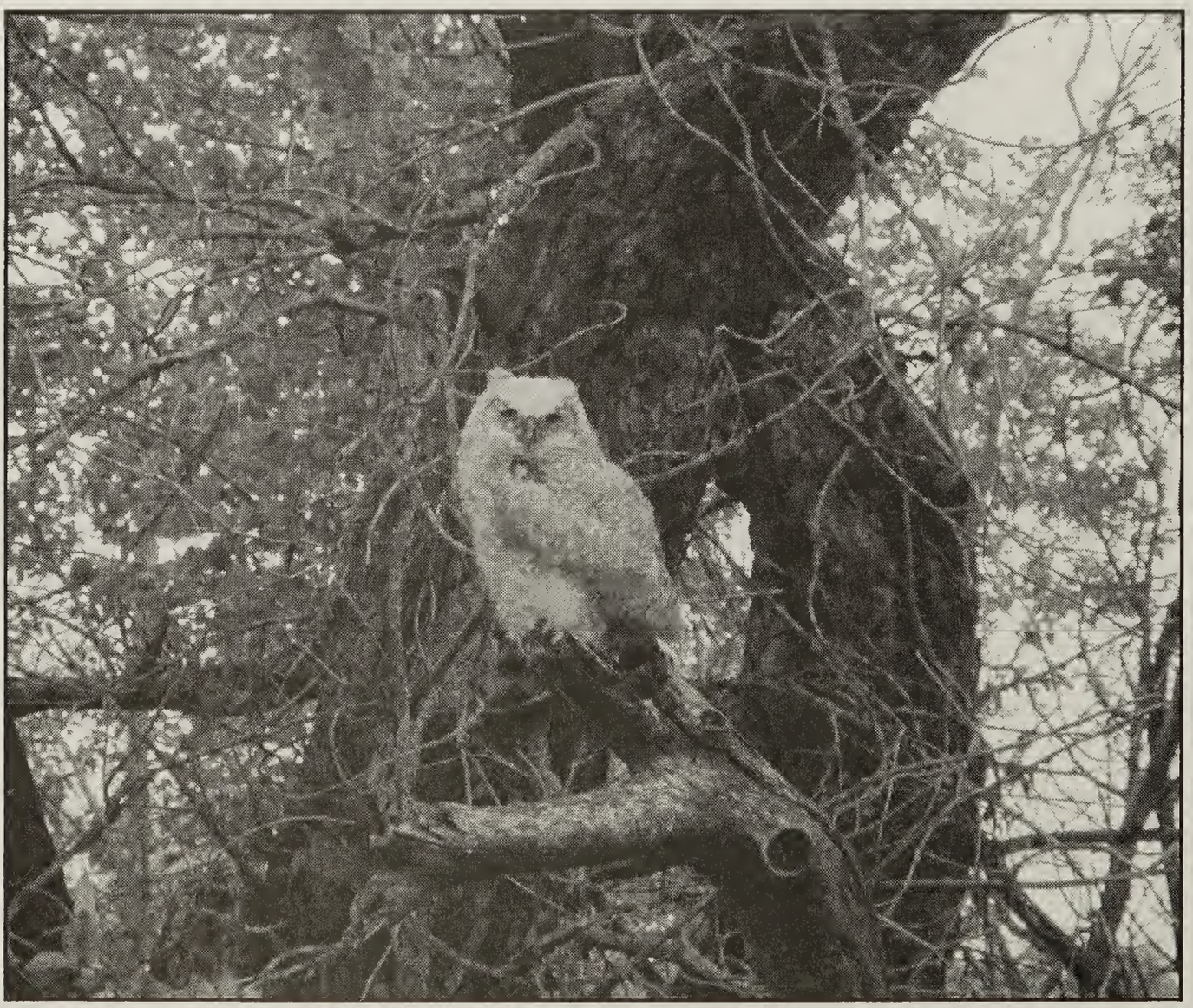

Young Great Horned Owl near Eastend, 4 June 2001 ***Bob Davis***

THE BIOLOGY OF *Trillium cernuum* (Liliaceae)

TOM REAUME, 212 Sherburn St., Winnipeg, Manitoba R3G 2K6

Introduction

The Whip-poor-will-flower, *Trillium cernuum*, is a native perennial that grows in deciduous wooded areas, coniferous swamps and moist thickets along edges of bogs, rivers and streams. This rhizomatous, long-lived, vernal herb produces a single white flower per stem which develops into a red berry. Hanging on a reflexed pedicel, the perfect flower faces the forest floor and is hidden beneath an apical whorl of three subsessile leaves (Fig. 1).

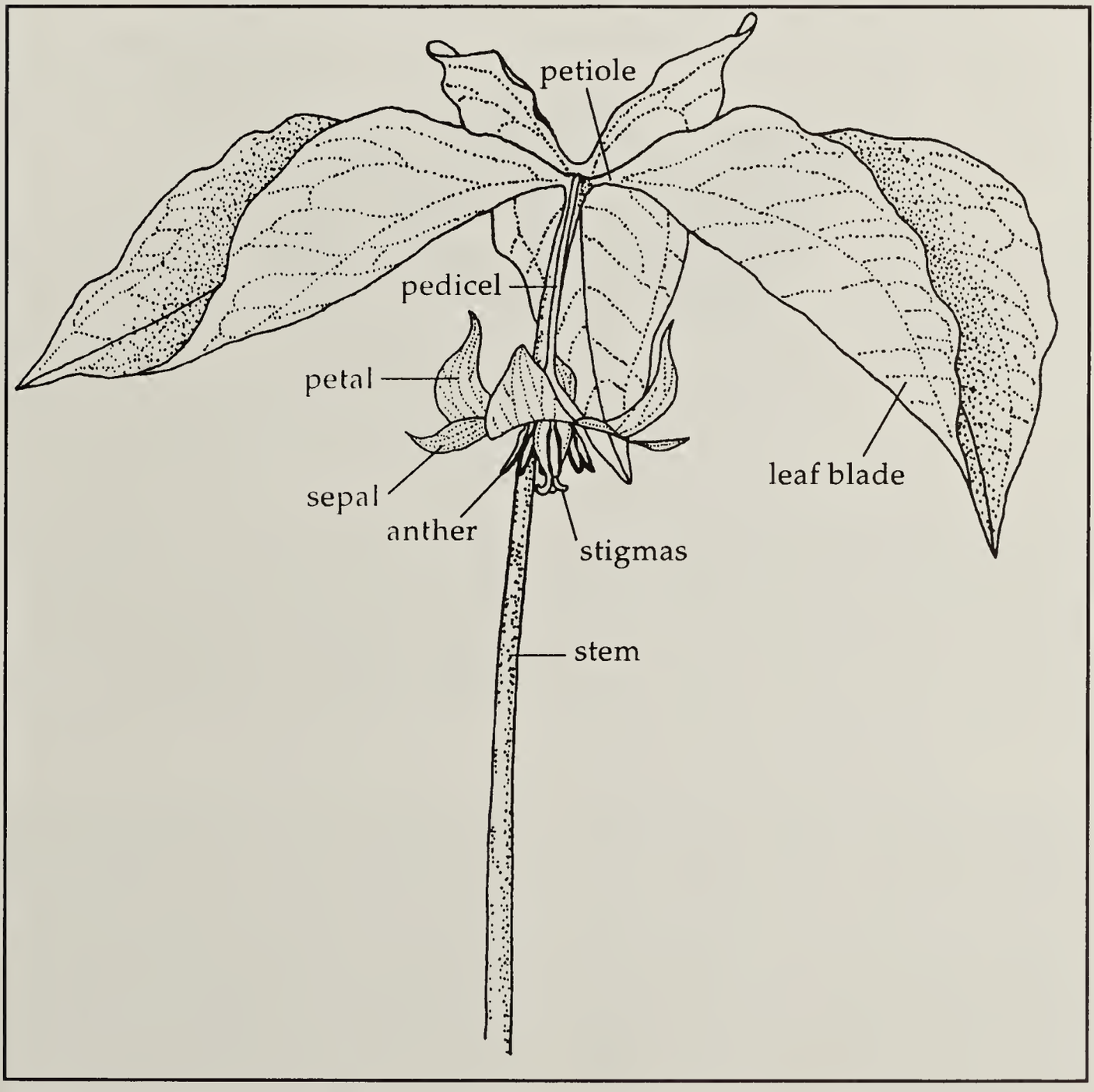

Figure 1. Upper plant form of a single-flower (SF)* Trillium cernuum. *x 1

T. cernuum is the only trillium species in Manitoba and Saskatchewan. In Canada, its range extends from eastern Saskatchewan to Newfoundland, occupying parts of eight provinces. In the United States it is found in 21 states, from the Dakotas to Virginia and northward along the Atlantic coast to Maine (Fig. 2). Reports of *T. cernuum* in Georgia and Alabama appear in earlier publications[15] but have since been negated.

environmental factors, microhabitat and age of the plants. This is also true for six populations of Stinking-benjamin, *T. erectum*, in Ontario, in which there was much phenotypic variation among and within populations, and about one-third of the size variations in floral parts was dependent on plant size within a population.[37]

In 2001 and 2002, I undertook a study of

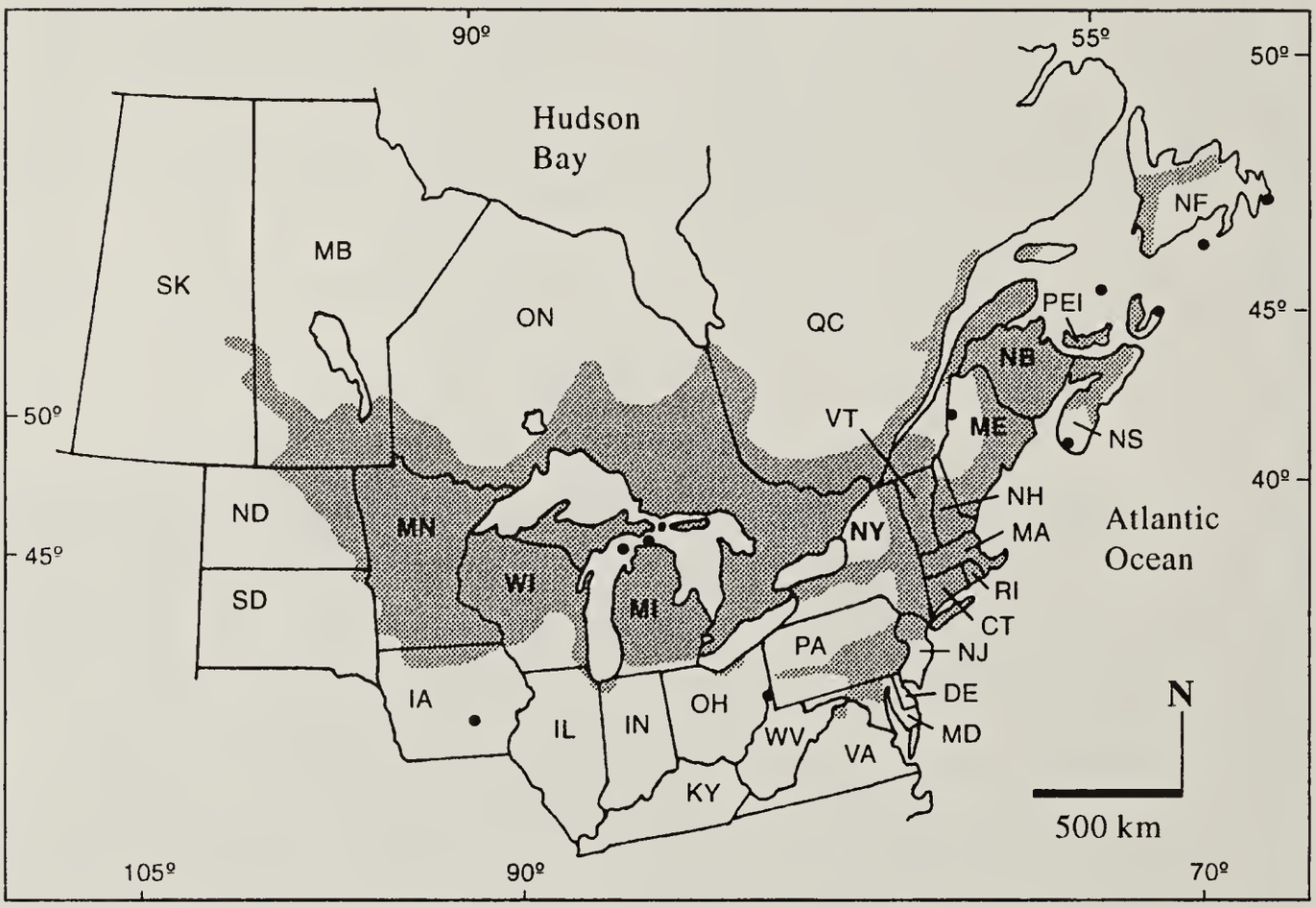

Figure 2. The range of the Whip-poor-will-flower,* Trillium cernuum *in Canada and the U.S.A. The following references were used to compile the range shown in Map 1 : 3, 4, 6, 7, 9, 20, 22, 27, 29, 30, 33, 36, 38, 39 and 45 in addition to information from 38 herbaria (listed in the acknowledgements) contacted directly by the author.

Kartesz lists 39 species of the genus *Trillium* in North America.[24] The Cases list 43 species.[6] Both, however, agree that the two previously recognized varieties of *T. cernuum*, – variety *cernuum*, a small-flowered eastern plant and variety *macranthum*, the large-flowered western plant – are not discrete enough to be maintained. The size variations throughout the Whip-poor-will-flower's range are due to a combination of genetic and

T. cernuum to describe its habitat, range, habit, phenology, pollination, age, plant parts, reproduction and seed dispersal in one isolated population in Winnipeg. Relationships to herbs, shrubs and trees were also noted as were predation by mammals and interactions with invertebrates. This article presents some of the results of this study along with an analysis of ageing Whip-poor-will-flower plants using characteristics of the rhizome.

This study was undertaken for two reasons: to provide a more complete account than is currently available in floras, and to provide baseline information about this species. Only three small papers have been dedicated to the biology of the Whip-poor-will-flower.[10,11,18]

All common and scientific botanical names used in this article follow those in the Biota of North America Program (BONAP).[24]

The ink drawings were completed over two years from fresh specimens, using a dissecting microscope when necessary to view fine details. The drawings are labeled to identify parts mentioned in the text.

Materials and methods

Field study site

A wild population of *Trillium cernuum* was studied at Assiniboine Park in Winnipeg (49° 52' N, 97° 15' W) in southern Manitoba. The population forms a natural community in a second-growth deciduous forest of Burr Oak (*Quercus macrocarpa*), Green Ash (*Fraxinus pennsylvanica*), American Elm (*Ulmus americana*), and American Basswood (*Tilia americana*). About 23,000 Whip-poor-will-flower plants grow over about 9,500 m^2 (trails excluded) along the south shore of the Assiniboine River immediately east of the manicured English Garden. *T. cernuum* occupies an elevated, non-rocky, flat to undulating riverbank which is rarely flooded. Numerous walking/bicycle trails (paved, gravel, and natural) fragment this woodland population.

The site is about 232 m in elevation. The frost-free period averages 121 days. The average date for the last spring frost is 23 May and the first autumnal frost, 22 September. The average annual rainfall is 41 cm and snowfall 126 cm. May through September are usually without snow cover. The deepest snow cover occurs in January and averages 32 cm.[34]

Plant Categories

The Whip-poor-will-flowers were assigned to eight categories based on growth

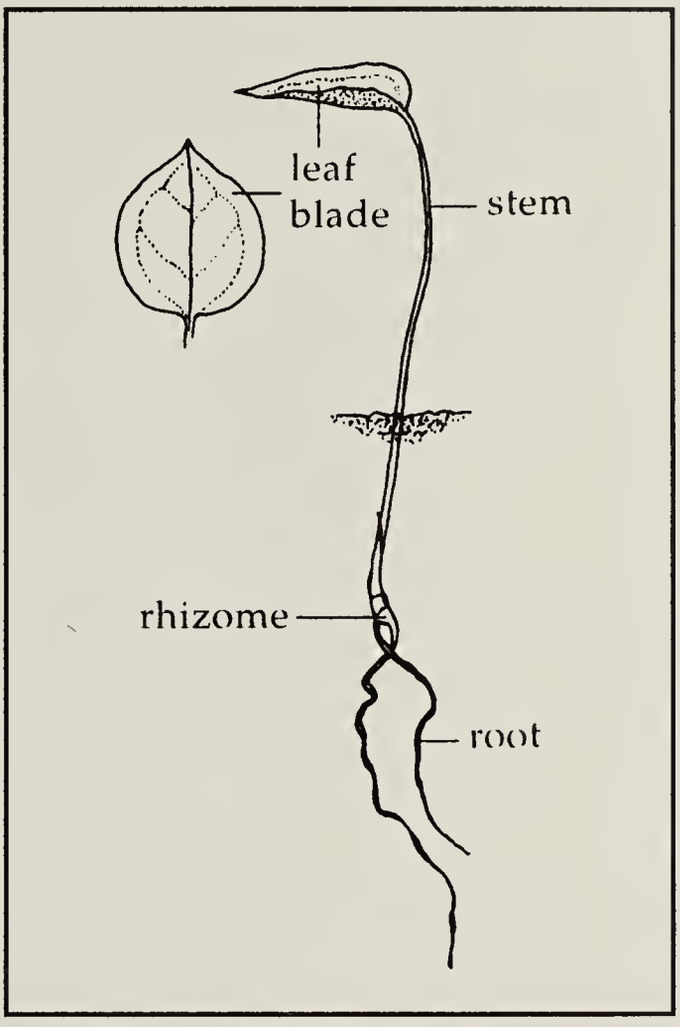

Figure 3. Vegetative plant with one leaf (V1), first appearing above the ground in its second spring. x 1

form, which are referred to throughout this paper by these abbreviations:

(V1) vegetative, 1 leaf: young vegetative plants with a single stem and one leaf (Fig. 3).

(V2) vegetative, 2 leaves: young vegetative plants with a single stem and two terminal leaves (Fig. 4).

(V3) vegetative, 3 leaves: vegetative plant with one stem and three leaves (Fig. 5). This was the most abundant growth form.

(V4) vegetative, 4 leaves: vegetative plant with a stem and four leaves in an apical whorl. Only one plant of this growth form was located.

(DV) vegetative doubles: vegetative plants with two stems (< 5 mm apart at ground level) arising from the apex of one rhizome; each stem has three leaves.

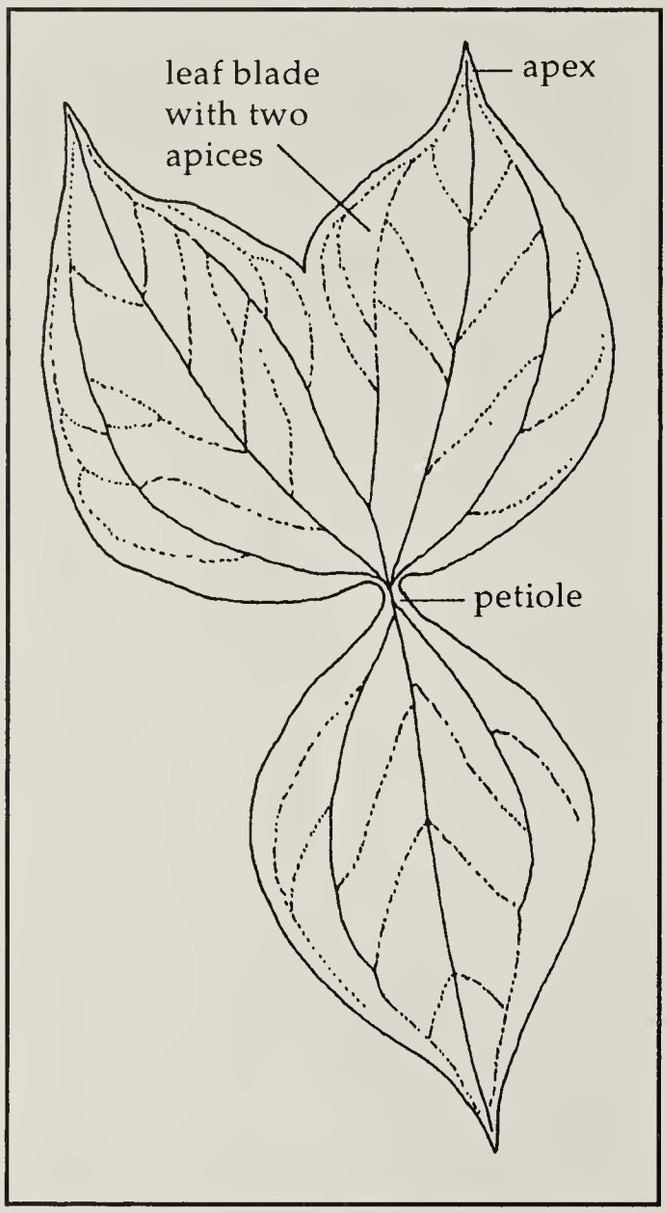

Figure 4. Vegetative plant with two leaves (V2), as seen from above.

(SF) single-flower: plants with one stem, a flower and three leaves (Fig.1).
(half DF) half double-flower: plants with paired stems and each stem has three leaves but one stem carries a flower and the other stem is vegetative with an undeveloped flower < 10 mm long atop the stem where the petioles meet.
(DF) double-flower: plants with paired stems from a single rhizome and each stem has three leaves and one flower.

Field Procedures

The field work period lasted from 1 May to mid-October in 2001 and 2002.

Sample areas Eight randomly-placed quadrats and several two meter wide transects, along with both systematic and

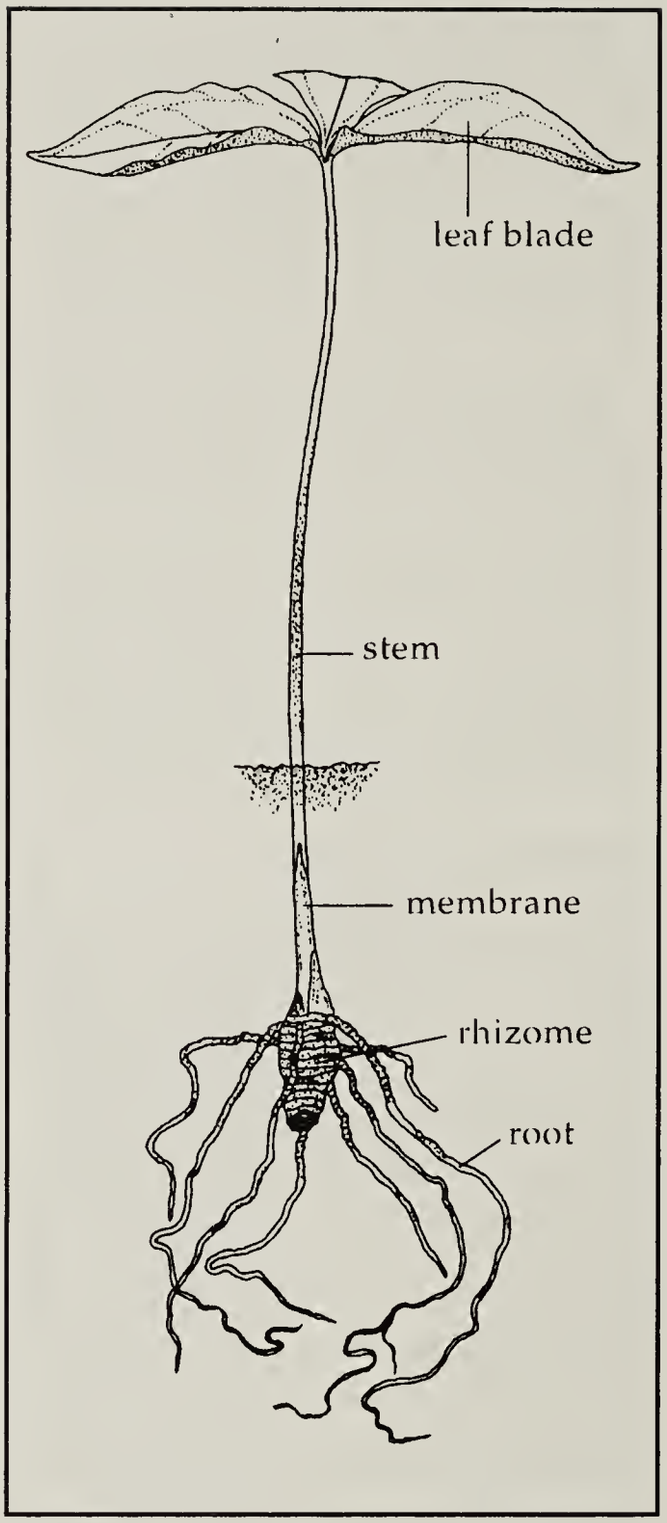

Figure 5. Vegetative plant with three leaves (V3). x 0.8

casual searches, were used to sample the population in May through September. Systematic and casual searches provided data on the double plant categories not sampled adequately by the quadrats and transects, as well as the smallest and largest plants in each category and phenology. The one V4 plant (vegetative with four leaves) was also located in a casual search. Compacted trails prohibited the growth of Whip-poor-will-flowers and were not included in any sampling technique. The eight 2 x 4 m

quadrats were positioned on 14 May 2001 as the plants were beginning to flower. The long axis of four quadrats ran north-south and four, east-west.

Measurement of plant parts In 2001, all Whip-poor-will-flowers within each quadrat were counted, measured and mapped. For plant parts in multiples, i.e., sepals, petals, leaves and stamens (Figs. 6 & 7), only one member of each group was measured on each plant. The leaf opposite the pedicel was

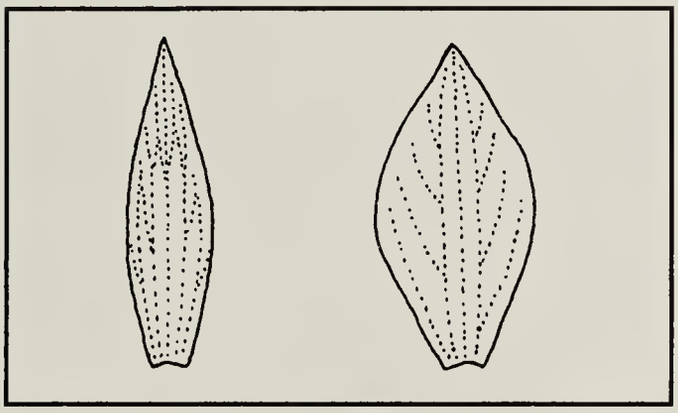

Figure 6. Perianth parts: green sepal (left) and white petal (right). x 1

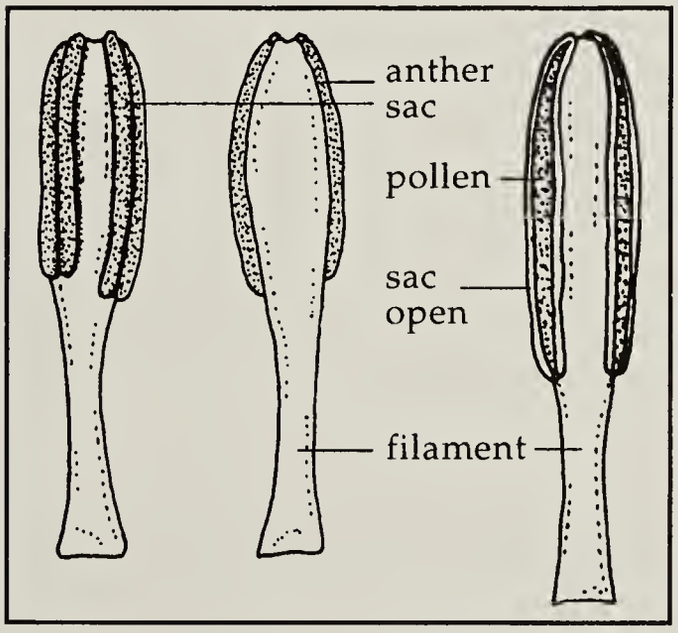

Figure 7. Stamens before (left pair), and at (right), anthesis. x 5

measured when a flower developed. Plants in the quadrats were measured on six days from 18-27 May 2001. As this was too early to measure stem, leaf and pedicel which were still growing and about 15% below their full expression, these were measured in early July 2001. Callipers were used to measure widths of stems near the ground and pedicels midway along their length. For double-flower (DF) plants, flowers were measured in late May 2001 shortly after opening. Plant parts other than flowers were measured in late June 2002.

Ageing experiment Outside the quadrats, ten plants in each of four categories (V1, V3, SF and DF) and a range of sizes were selectively sampled in July-August 2002 for ageing by features of their rhizomes.

Plant density The distances from each trillium to the nearest trillium and nearest non-trillium (herb, shrub and tree) were measured for plants in quadrats and some transects. Diameter of the nearest shrub was obtained about 1 cm above ground for those < 50 cm tall; at the 10 cm height for those in the 50-100 cm range; and at the 50 cm height for shrubs > 100 cm. Diameters of trees were taken at breast height (dbh).

Ovules and seeds For single-flower (SF) plants, ovules per pistil were counted in early June 2001 before much expansion took place. Plump, almost ripe seeds were counted in late July and early August 2001 to determine the number of seeds per berry and percentage of seed set. For double-flower (DF) plants, nearly ripe seeds were counted in late July to early August 2001. Fruit width and length were obtained on 18 August 2002, about a week before fruit began to fall from the plants.

Predation From 13 May through 8 June 2001, I measured trillium stem bases recently browsed by White-tailed Deer. Distances browsed stems to the nearest trillium were also noted.

Results and Discussion

Phenology in 2001

3 May: *Trillium cernuum* first appear above the snowless ground, leaves erect around the erect flower bud (Fig. 8); **14-28 May**: flowering period; **13 June**: fertilized ovules are about 1 mm long, the pistils white except for a blush at the base of the stigmas,

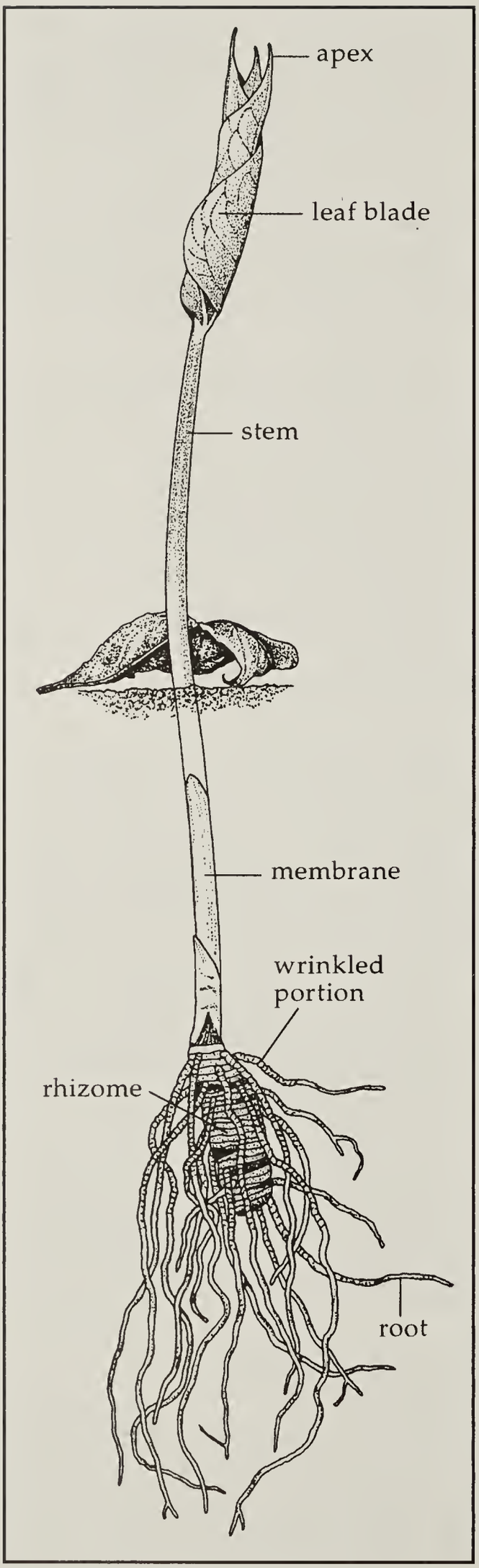

Figure 8. **Trillium cernuum** *emerging, 3 May 2001. x 0.8*

the crown buds are 3-8 mm long; **29 June**: ovules are white and most 2-2.8 mm long, soft and milky, with pale yellow elaiosomes about 1.5 mm long (Fig. 9); **8 July**: ovaries pink; **20 July**: ovaries red, dull; **7 August**:

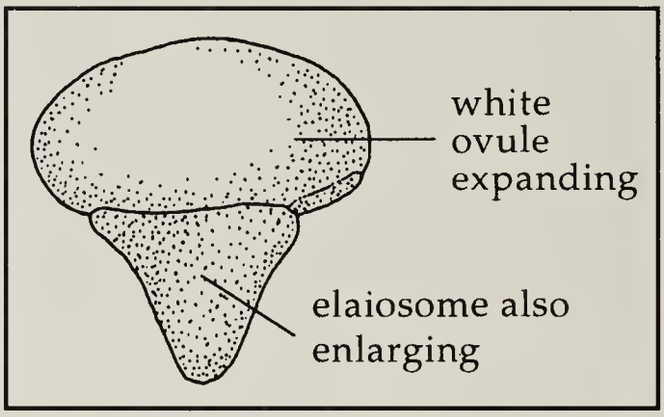

Figure 9. Growing white ovule and its pale yellow elaiosome, 1 July 2001. x 10

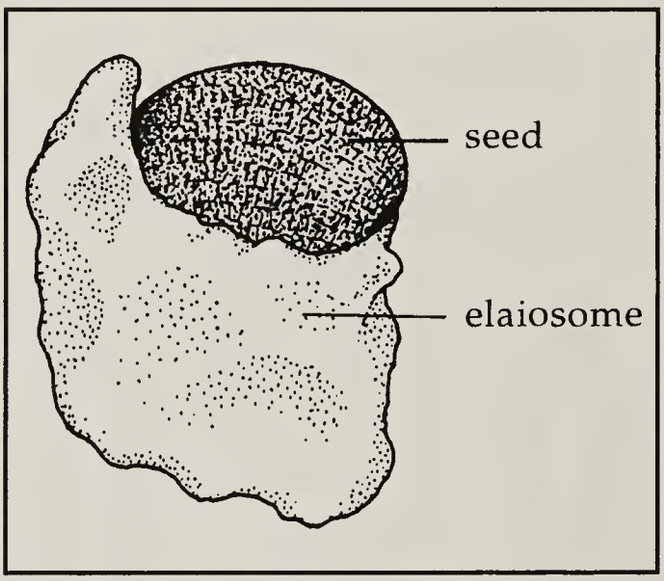

Figure 10. Seed with attached elaiosome, mid-August. x 8

some seeds brown, elaiosomes pale yellow and stiff (Fig. 10); **13 August**: berries shiny, red and still attached to plants; **20-27 August**: ripe fruit drops, the elaiosomes are mushy and the sepals mostly green; **5 September**: crown buds continue to grow, leaves are still green on many vegetative and reproductive plants; **15 September**: crown buds are white and 2-5 cm long, the longest buds on double-flower (DF) plants have their tips several mm above ground, deciduous tree leaves begin to fall, the first light frost occurred a few days earlier; **10 October**: no upright trillium plants remain, a fresh layer of fallen deciduous tree leaves covers the

population, there is no snow on ground. **Note**: The cool spring in 2002 delayed the start of flowering until the 29th of May. Ripe fruit dropped from plants in late August, generally, as it had done in 2001 above.

Quadrats

Trillium cernuum plants were found in all eight quadrats. Within the quadrats in 2001, the plants (n=159) were: V1 (10%); V2 (3%); V3 (68%); SF (18%); and predation by deer (1%) (Fig. 11). The sample size of 159 plants amounted to 0.7% of the total population.

The lack of doubles in my quadrats indicates the size of the area sampled (64 m^2) was inadequate to record all seven of the main plant categories in the population. The quadrats with the smallest and largest number of plants, 6 and 37, held only vegetative plants. Within the eight quadrats the population had an abundance of 2.5 plants per m^2 or 0.4 m^2 per plant.

Plant categories

An assumed progression of a plant from a V3 to SF and to the DF category may not always take place. Of the 100 or so plants marked with a plastic stake in 2001, I re-located 36 in 2002. Some switching of categories did occur from 2001 to 2002, briefly: V3 to V3 (6%); V3 to SF (3%); V3 to DF (8%); SF to SF (25%); SF to DF (25%); DV to SF (3%); DV to DF (3%); DF to DF (25%); and finally DF to DV (3%).

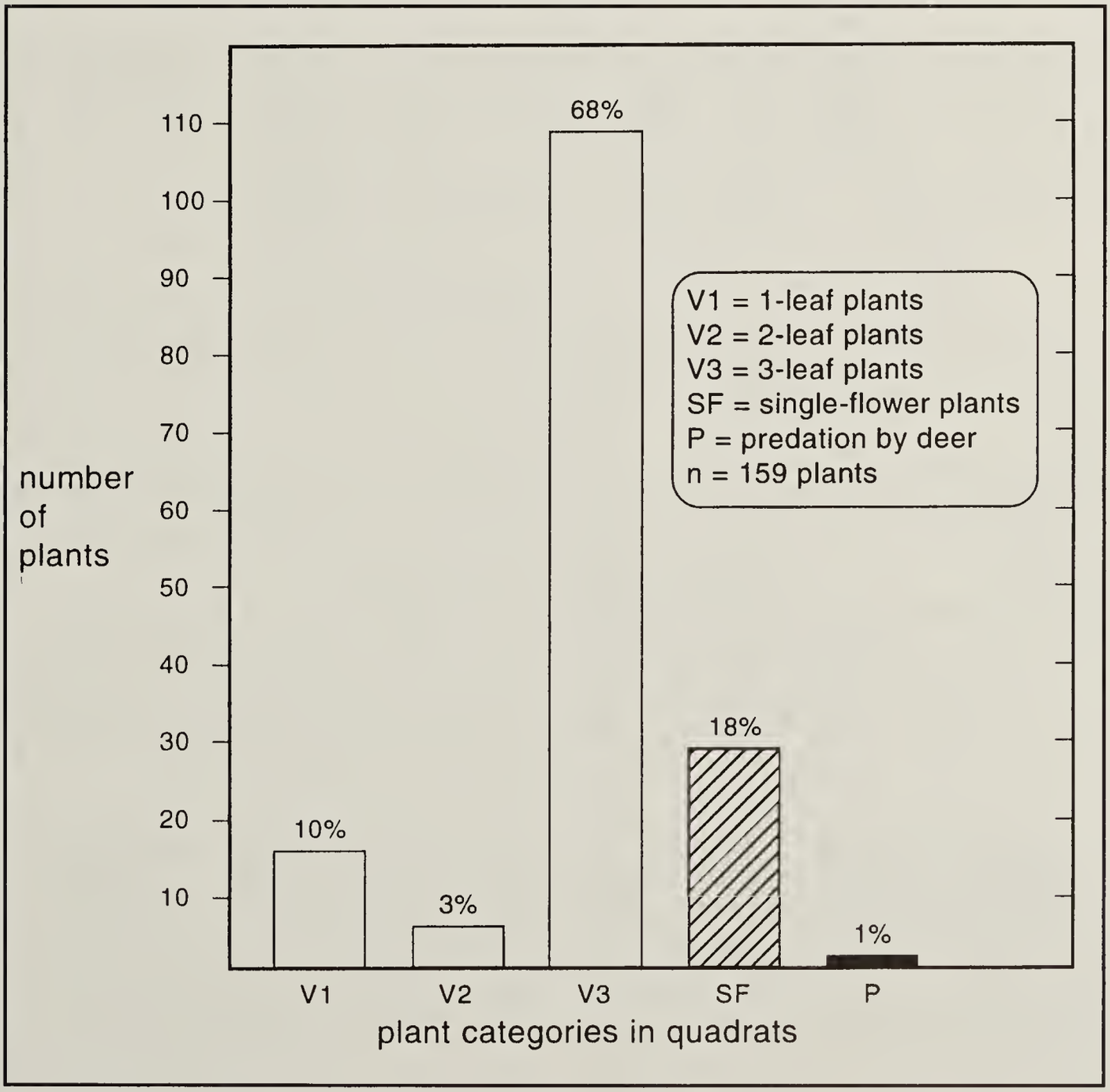

Figure 11. Four plant categories of* Trillium cernuum *measured in eight 4 x 2 m quadrats in 2001. Deer predation (P) is noted.

Of special interest were the three vegetative, three-leaf plants in 2001 which emerged as small double-flower plants in 2002. Had these three plants carried a single flower before 2001, or did they skip the single-flower (SF) phase and go directly to the DF category?

It also appears that older plants do not maintain their double-flower status forever. The largest double-flower (DF) plant in 2001 reverted to a large double-vegetative (DV) plant in 2002. Elsewhere, on one rhizome of a double-flower plant the three previous years produced large paired stem scars but the scars don't indicate if the aerial double stems bore flowers.

In New Hampshire, large Stinking-benjamin plants also underwent some categorical changes over two years: V3 to V3 (2%); V3 to SF (1%); SF to SF (85%); SF to DF (2%); DF to SF (6%); and DF to DF (4%). From 1979 to 1980, no flowering plants changed to a vegetative state.[8] Overall, the populations remain fairly stable from year to year according to short term research.

Description of plant parts

Tables 1 and 2 present comparative measurements of stems, leaf blades, pedicels, flowers and flower parts of *Trillium cernuum.* Other plant parts are described below.

Category (Vegetative)	n = # of stems	Stem length	Stem width	Leaf Blade length	Leaf Blade width	Pedicel length	Flower length	Flower width
V1 (1-leaf)	84	6.0 2.1–10.2	0.1 0.04–0.15	3.4 1.3–5.8	2.8 0.8–5.8			
V2 (2-leaf)	8	8.6 7.2–10.3	0.14 0.1–0.2	4.1 (1 pt) 3.1–5.6 4.1 (2 pts) 3.2–5.5	2.4 1.8–3.4 3.7 2.5–5.6			
V3 (3-leaf)	107	17.5 5.8–29.9	0.22 0.1–0.32	7.4 3.3–11	5.5 1.7–10.2	0.03–0.2	0.1–0.75	
V4 (4-leaf)	1	19.5		7.2	5.4			
DV (Double-vegetative)	10	33.1 26.2–39.2		8.6 7.6–10.3	8.3 6.5–10.7		0.4–0.7	
(Flowering) SF (Single-flower)	103	32.8 22.8–50	0.38 0.25–0.68	10.6 6.5–15	9.7 6.1–15.8	4.1 2.7–7.2	2.2 1.8–3.2	3.4 2.2–5.7
Half DF (Half Double-flower)	4	Flowering / vegetative 31.7/25.4	0.39/0.35	Flowering / vegetative 10.6/9.9	8.7/8.2			
DF (Double-flower)	128	33.9 23–46.6	0.5 0.3–0.7	10.9 8–15.5	10.4 7–16.2	3.7 2.6–5.4	2.6 (n=28) 2–3.8	3.9 2.8–5.8

Table 1. Measurements (in cm) of* Trillium cernuum *plants growing in quadrats in Assiniboine Park, Winnipeg; means above ranges. Pt = point on a leaf.

Category (Flowering)	Sepal length	Sepal width	Petal length	Petal width	Fruit (n=104) length	Fruit (n=104) width	# seeds per berry
SF (n=103) (Single-flo.)	2.0 1.6–3.5	0.7 0.6–0.9	2.3 1.8–3.5	1.2 1–2	1.5 1–2	1.8 0.9– 2.5	40 (n=110) 11–158
DF (n=28) (Double-flo.)	2.5 1.8–3.4	0.9 0.5–1.2	2.7 2.1–3.7	1.4 1.1–2	1.7 1–2.6	2.1 1.4–2.7	80 (n=26) 38–132

Table 2. Flower parts and fruit measurements (in cm) of single-flower (SF) and double-flower (DF) plants growing in quadrats in Assiniboine Park, Winnipeg; means above ranges.

Undeveloped flowers These occurred on V3, DV and half-DF plants and were most noticeable on tall vegetative stems (Fig. 12). On small V3 plants, a tiny flower 1-1.5 mm long appears as a white dot to the unaided eye. Under a dissecting microscope, it has a white perianth about 1 mm long. In large undeveloped flowers, the imbricate, dry flower parts are brown atop a 1.5 - 2 mm (8 mm in one case) long green pedicel. These closed flowers consist of erect sepals and petals, and stamens about 2 mm long around a slightly shorter pistil. No undeveloped flowers existed on Dwarf White Wakerobin, *T. nivale*, in Ohio.[31]

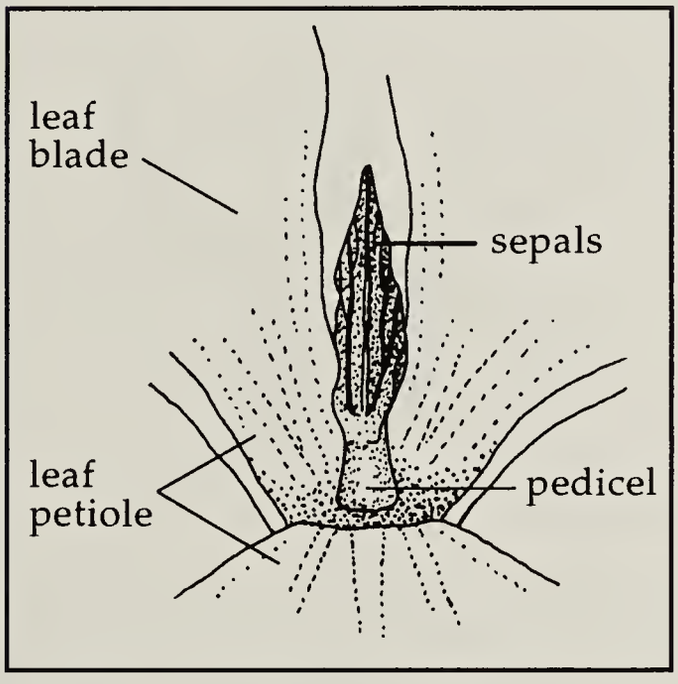

Figure 12. An undeveloped erect flower at the stem apex of a tall three-leaf plant (V3) where the three petioles meet. x 3

Stamens Stamens number six (58%), three (4%), or five (38%), and develop opposite each sepal and each petal. Stamen length is 7-12 mm. When only three stamens develop, they are opposite the outer whorl of three sepals. The filaments are white, slightly curved and about as long as the curved anthers. The stamens usually extend to the top of the three recurved stigmas. The anther sacs are usually purple (sometimes pale yellow) and attached along their full length to the sides of the stout 3-5 mm long filaments (Fig. 7). The sacs are 4-7 mm long and begin to split 12 or more hours after the flower petals open. Takahashi describes the pollen as white (I see fresh *T. cernuum* pollen as whitish tan) and 19-31 microns in diameter, smooth and of subtype IV with granulate exine ornamentation. The surface granules are of two types: large ones 1.0 micron in diameter and small, more numerous granules < 0.1 micron in diameter.[44]

Pistil. The pistil consists of a tricarpic ovary, with a 2 mm long style (persistent in fruit) which branches abruptly into three stigmas (Fig. 13). The ovary is white and 6-

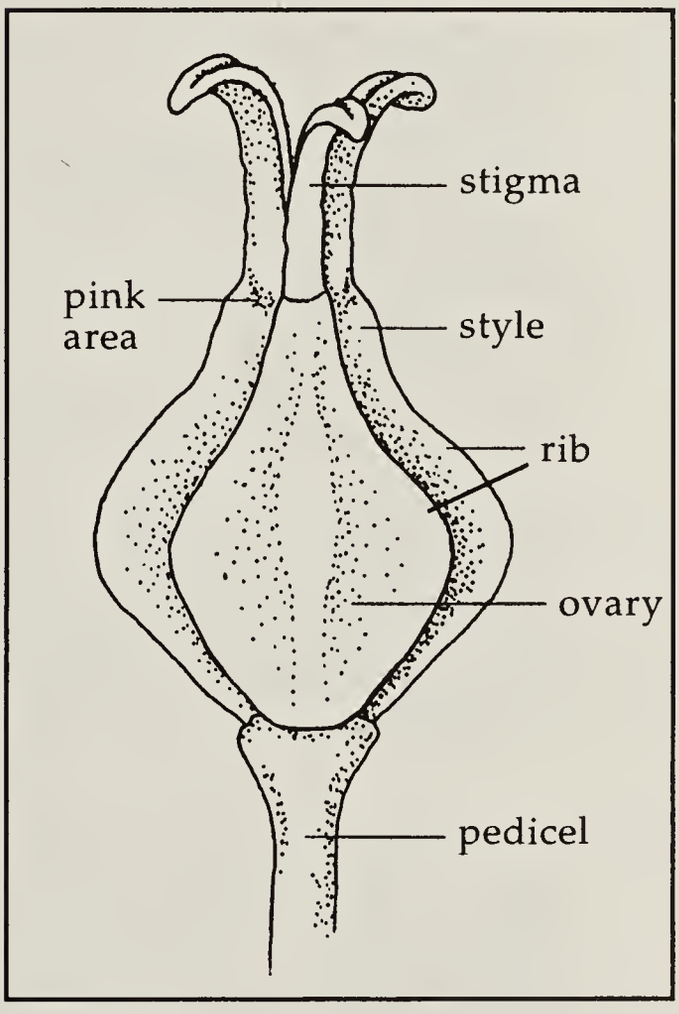

Figure 13. Superior pistil at anthesis with perianth and stamens removed. x 5

ribbed with a mean length of 10 mm (7-16) and a width of 6 mm (5 -10). The ribs, a continuation from the outer margins of the three stigmas, are erect to slightly leaning. The three sides of the ovary opposite the sepals are less concave than the sides opposite the petals and have a low vertical line which marks the center of the locule inside (Fig. 14). The stigmas are white, recurved and 3- 4 mm long by 4-9 mm wide (all three measured together).

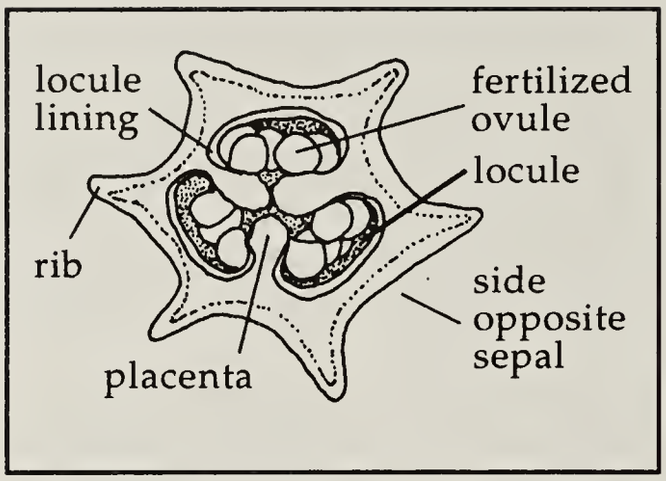

Figure 14. Cross-section of an ovary about 1 week after anthesis, 3 June 2002. x 5

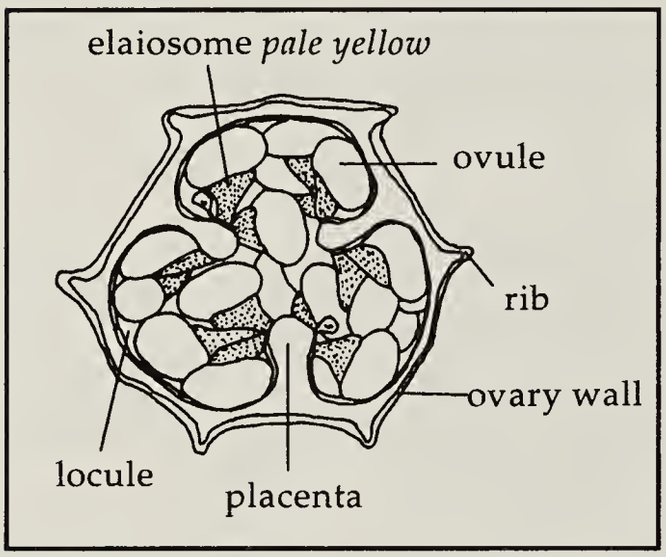

Figure 14a. Cross-section of an ovary, 1 July 2001. Enlarged ovules and elaiosomes almost fill the three locules. x 3

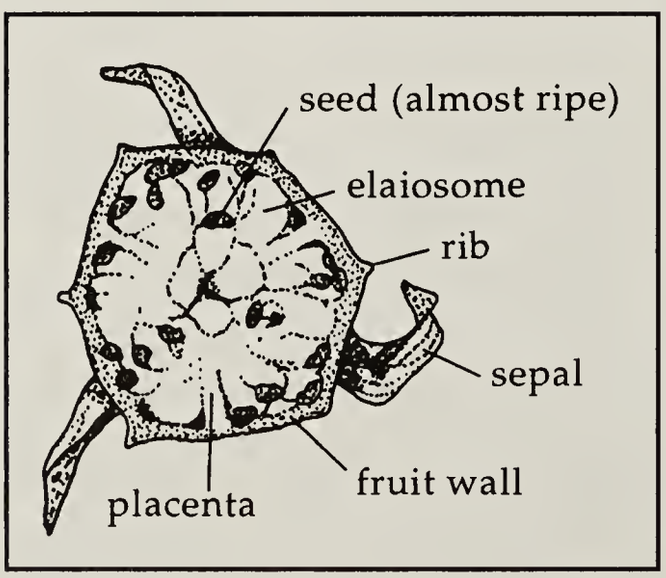

Figure 14b. Cross-section of an almost ripe fruit, 16 August 2001. Pale yellow elaiosomes fill the locules and push many seeds against the locule lining inside the fruit wall. x 1

Changes to the ovary as the fertilized ovules develop into seed are shown in Figs.14a and 14b. In early June 2001, the light yellow ovules of single-flower (SF) plants (n=21) were about 0.5 mm long. The mean number of ovules per SF ovary was 50 (24-101). For Dwarf White Wakerobin the range for ovules was 13-83 in three populations.[31]

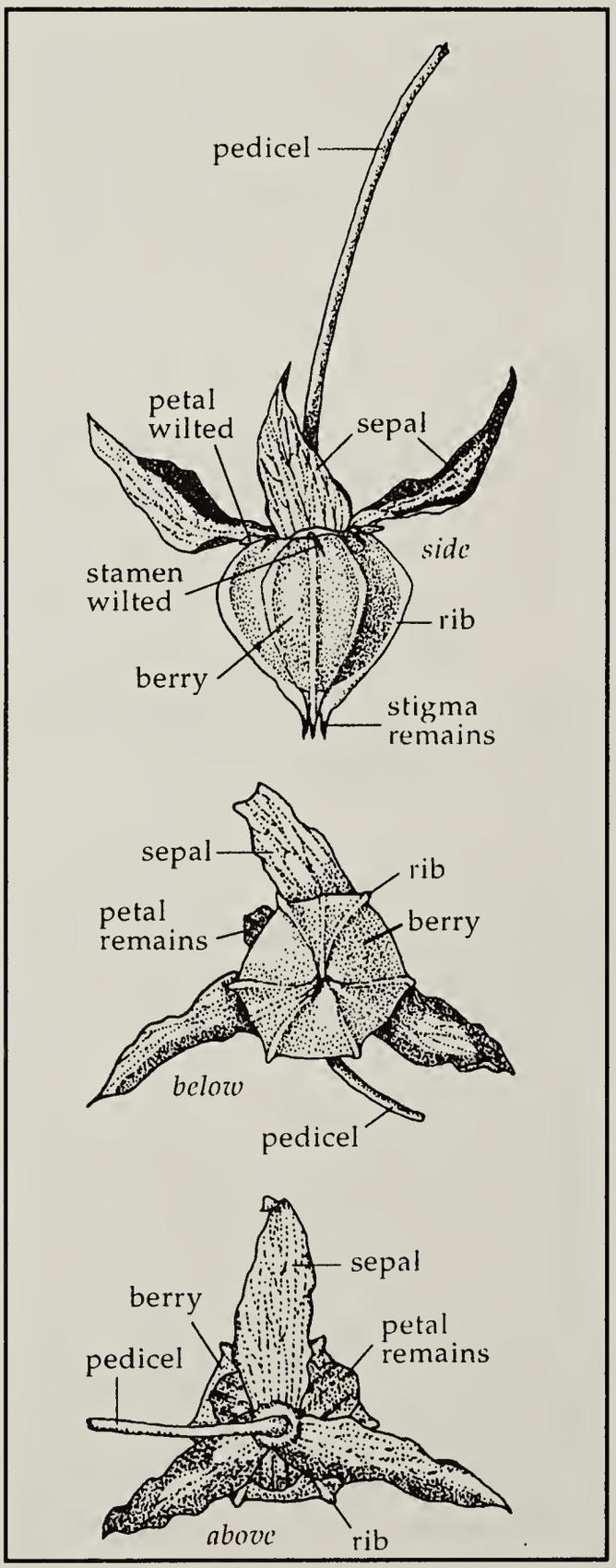

Figure 15. Red ripe fruit from three aspects, 7 August 2001.

Fruit The fruit is a red, shiny, plump, indehiscent berry, with a faint sweet odour when torn open. It hangs down at the end of the reflexed pedicel (Fig. 15). The six red

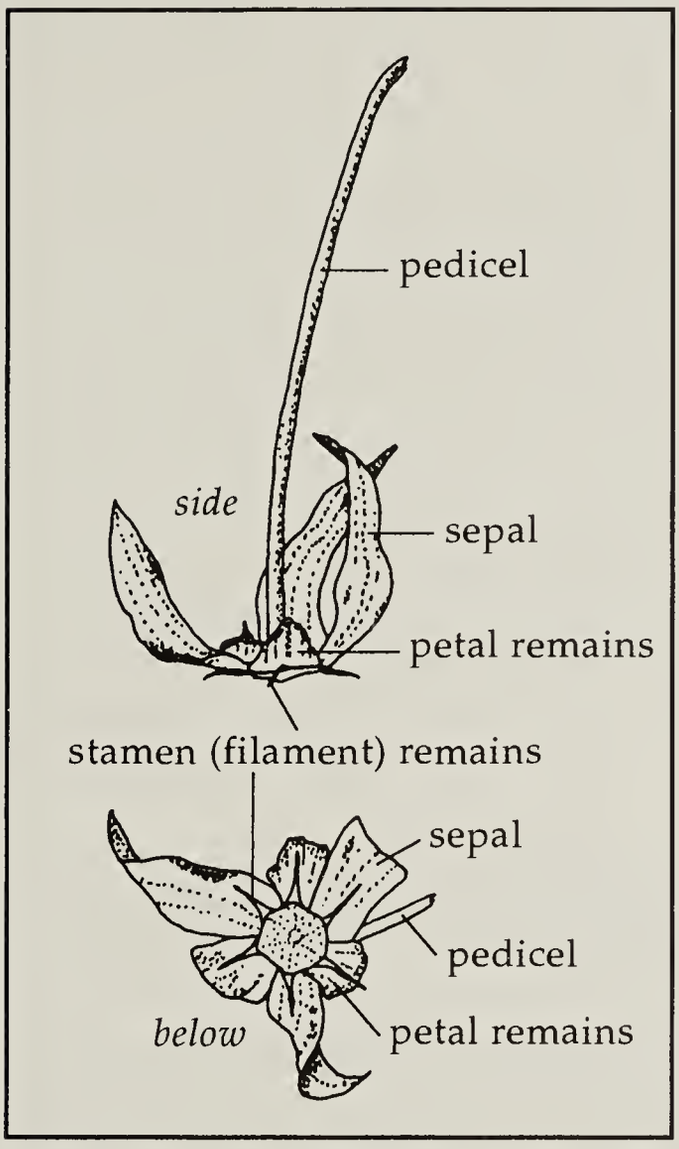

Figure 16. Green sepals and wilted petals remain attached to pedicel after the berry falls to the ground, 23 August 2001. x 1

ribs are more obvious on the smaller berries, almost disappearing on large plump ones. Fruit walls are smooth but reticulate (under a microscopic), 1-2 mm thick, fleshy, with a slight transparency which reveals some seeds inside. The locule lining is pink and indented from the seeds. The inside of the berry consists mostly of three placenta and moist, mushy elaiosomes attached to the seeds and placenta. The berry drops from the sepals and pedicel in late August (Fig. 16). It has no basal opening but is soft and the wall quickly disintegrates, or is easily opened by various consumers. Occasionally an almost ripe fruit on the plant displays a 3-5 mm wide circular opening on its upper side as if a consumer (a slug or a wasp?) is checking on the ripeness of the seeds and elaiosomes. Sizes of regular, single-flower (SF) fruit are presented in Table 2. Extreme (SF) fruit sizes were 24 mm long and 32 mm wide. The general trend is larger plants produce larger berries with more seeds. This trend exists for Stinking-benjamin and Large-flower Wakerobin in Vermont.[21] The fruit of double-flower (DF) plants was slightly larger on average than fruit of single-flower (SF) plants (Table 2).

Seeds The seeds are brown and their shiny, moist coat is finely reticulate (microscopic)

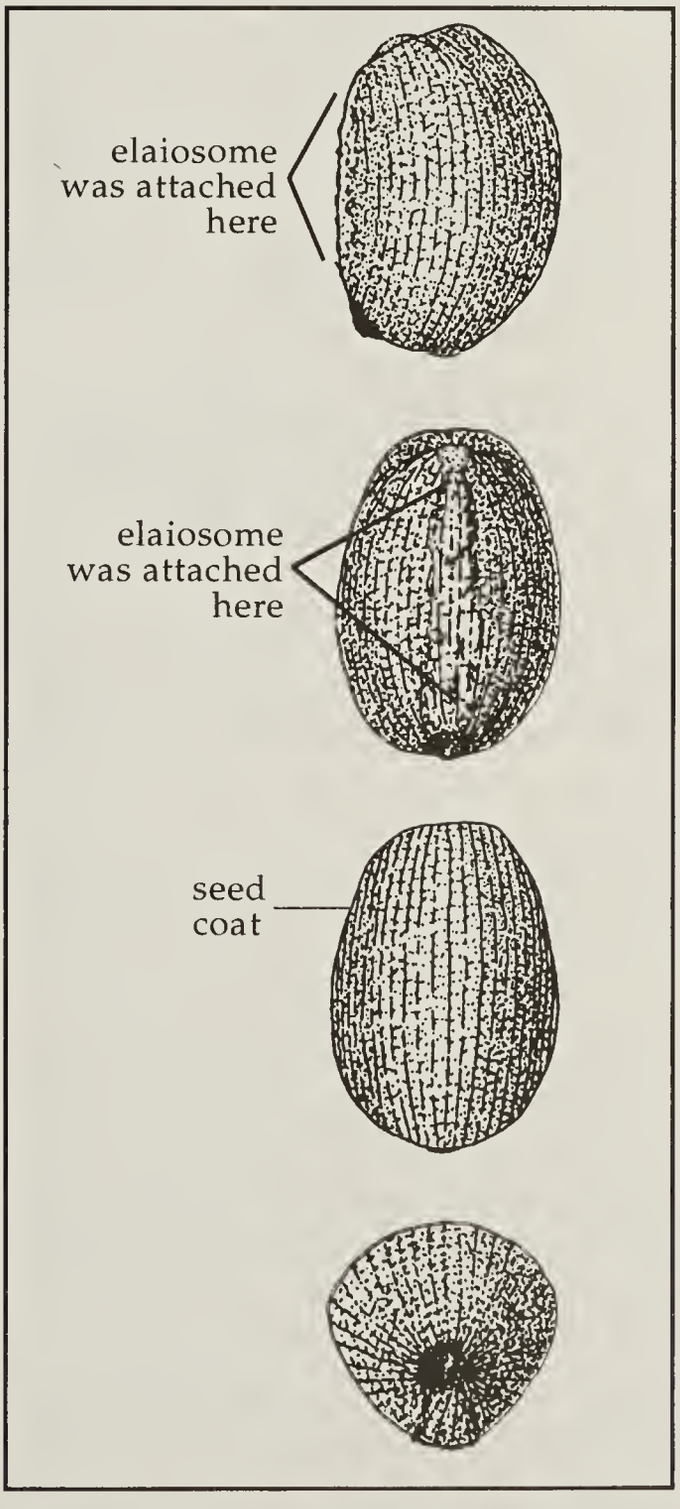

Figure 17. Seed of* Trillium cernuum *from four aspects on 23 August 2001. From top to bottom: side view, view of hilum region, top view, and end on.

when first removed from the berry, but dries quickly to a fine rough texture as the reticulation becomes less obvious (Fig. 17). As the summer progresses, the elaiosome (a moist appendage growing from the hilum region of the seed) grows until the seed is ripe. At first the elaiosomes are firm but turn mushy as the fruit becomes fully ripe and shiny red.

For berries from single-flower plants (n=110) the mean number of seeds per berry was 40, for a seed set of 40/50 ovules x 100 = 80%. DFs (n=26 stems) from 13 rhizomes had a mean of 80 seeds per fruit. The mean number of seeds in the two berries on the long and short stems for each rhizome was 85 and 74 for a difference of 11 seeds. With twice the number of seeds per flower and two flowers per rhizome, DFs have four times as many seeds as SFs.

For Dwarf White Wakerobin in Indiana, the mean number of ovules was 35 compared to 31 seeds for a seed set of 90%.[42] In two Ohio populations of Dwarf White Wakerobin, the mean number of ovules per pistil was 27 (13-74) and 27 (15- 43). Their mean number of seeds and seed set was 18 (67%) and 24 (89%).[31] A seed set of 58% and a mean of 28 seeds per fruit was reported for Stinking-benjamin in Quebec.[26] In New Hampshire, Stinking-benjamin had a seed set of 65% (15 seeds) for single-flower (SF) plants and 54% (22 seeds) for double-flower (DF) plants.[8]

Seeds are arranged in a vertical column with 3 to 10 filling a locule from top to bottom. There are from 1-3 horizontal rows on each side of the placenta in each of the three locules. The expanded elaiosomes comprise the bulk of the fruit (Fig. 14b).

With the elaiosome removed, the mean seed length (n=83) was 2.4 mm (2.0-3.0), width 1.7 mm (1.3-2.0), and thickness 1.7 mm (1.4-2.0). Without the elaiosome, seeds sink in water. With the elaiosome attached, some seeds sink while others float at the water's surface.

Leaves. On all plants except V1, V2 and V4, there are three leaves each with a 2-5 mm long petiole and blades up to 15.5 cm long (see Table 1). They are curled and imbricate on emergence (Fig. 8). The blades are dull and

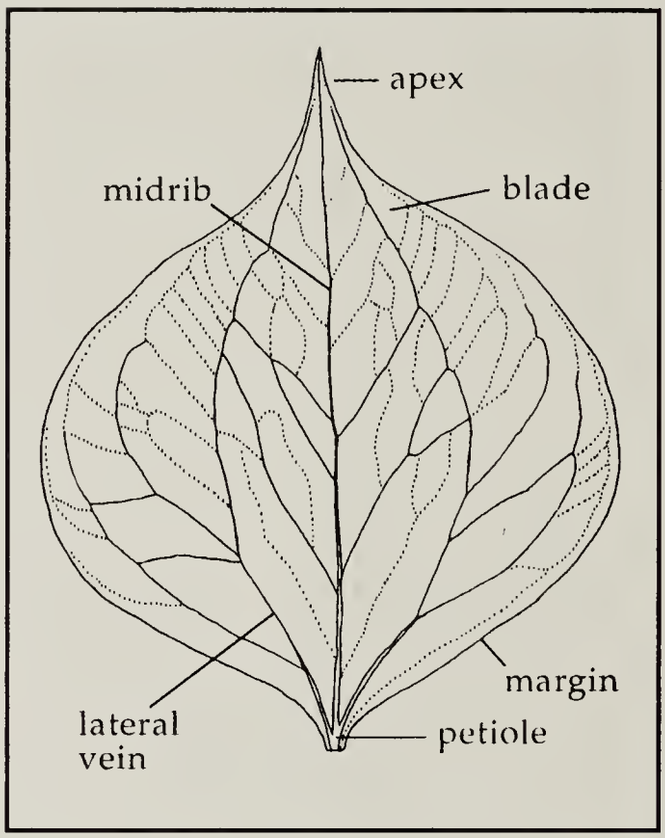

Figure 18. Leaf of* Trillium cernuum. *x 0.7

medium green above with the veins recessed (Fig. 18). The blades are lighter green below and slightly shiny with raised veins. Usually leaves remain mostly green and horizontal well after the fruit has fallen. Sometimes the leaves wilt early and hang to reveal the red ripening fruit in early August. The margins may be undulate, and in wide blades, touching. The three blades on one plant vary slightly in size as was the case for Stinking-benjamin in Ontario where the differences were not significant.[37] Most leaves are slightly longer than wide, but large leaves are wider than long. A large single-flower *T. cernuum* plant in 2002 had the largest leaf blade at 18.3 cm wide and 15.5 cm long. In Ontario, the leaves may reach 20 cm in length.[35]

Stems Plants have one or two stems per rhizome. In contrast, Giant Wakerobin, *Trillium chloropetalum*, may produce up to eight stems per rhizome.[5 in 31] Stinking-benjamin in New Hampshire can produce

up to five stems per rhizome, each with a flower.

Fully developed stems are reddish brown along the lower 2-7 cm, and become green above. The stem is rather weak, solid, roundly triangular in cross section, somewhat crisp, often slightly curved and easily bent. Lapointe found the amount of stored carbohydrate in the stem of Stinking-benjamin was more than enough to support fruit development in the laboratory over the summer, even with the leaves and rhizome removed.[26]

The previous year's stems (1-4 per plant) are brown, ridged along their length, flat, and lie on the ground extending out from the base of the erect stem like a tan shadow. One or two are usually attached near the top of the rhizome.

Rhizome Each plant has one rhizome. It is tan, cylindrical and 3-6 mm wide (n=10) for young, single-leaf, vegetative (V1) plants and becomes dark brown near the distant decomposing end in older plants. The inside of a rhizome is solid, pale yellow and uniform in texture. Rhizomes range from 3-46 mm long by 3-19 mm wide, increasing in size with age. They are usually widest at the apex (especially rhizomes with a crown bud in autumn) and tapered toward the base. The mean depth of rhizomes of vegetative and flowering (V1, V3, SF, and DF, n=63) plants was 5 cm below the soil (0.5-8.6), measured from the soil's surface to the rhizome's apex.

Rhizomes are often slightly bent away from the vertical of the stem's axis. Young vegetative (V1) plants have a straight, vertical rhizome. Some older flowering plants have a rhizome with a 90° bend somewhere along its length making the distal portion horizontal (Fig. 19).

Roots and crown buds arise from rhizomes, but no lateral buds were observed. Stem scars and membranous rings on the

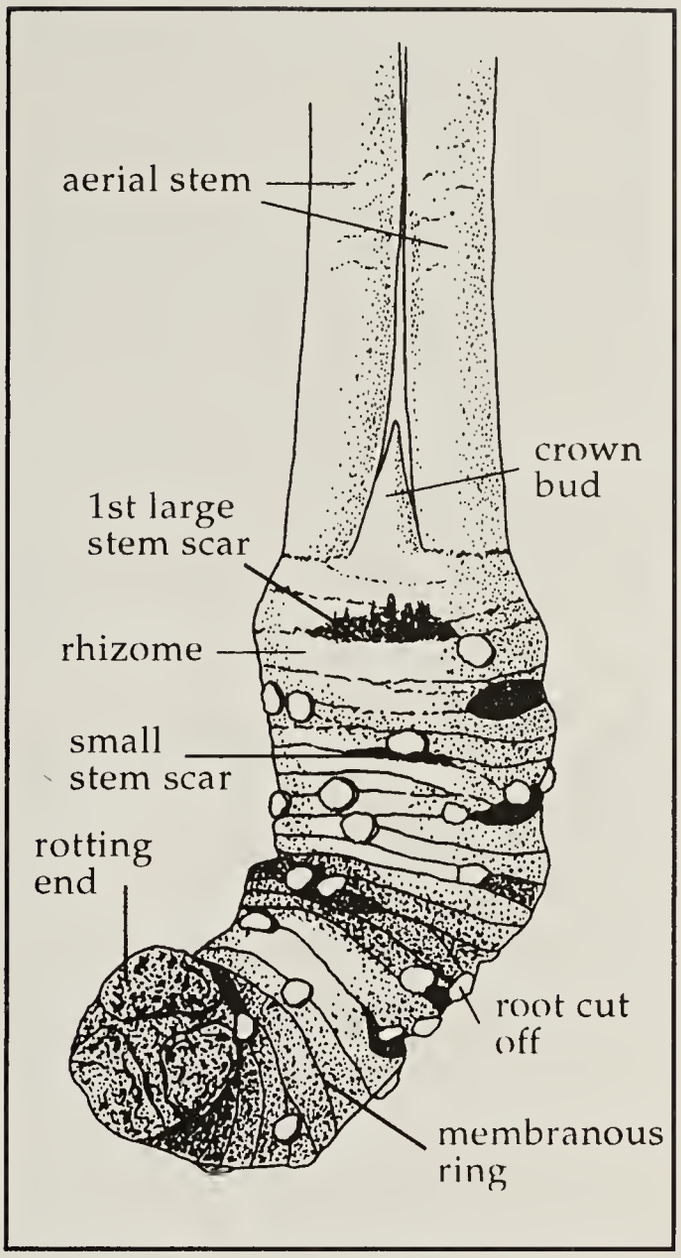

Figure 19. Rhizome of a DF plant showing its bend and other features, 18 June 2001. x 2

rhizome surface are used to age plants and are described in the section on ageing below.

Roots Roots range from 0.5-12 cm long by 0.4-2.5 mm thick. They vary in number from few on a young vegetative (V1) plant up to 53 on a large double-flower plant where they obscure the shape and size of the rhizome. New roots emerge near the top of the rhizome. Roots are light tan, smooth and mostly less than 2 cm long. Most roots are unbranched but some develop up to a dozen branches which in turn may rebranch.

Older roots have a wrinkled portion (contractile?) starting at the rhizome and extending out to about 4 cm in length (visible in Fig. 8). The distal part of these roots is

smooth. For Dwarf White Wakerobin the contractile portion was about 1 cm long nearest the rhizome.[31]

Crown buds Crown buds are buds of future plant growth sitting beneath the surface. Their membranous covers, which are white, smooth, erect and pointed, are underground at the base of the current stem (Fig. 19a). They begin to expand from a rhizome's apex as the berry ripens, and continue to develop into September.

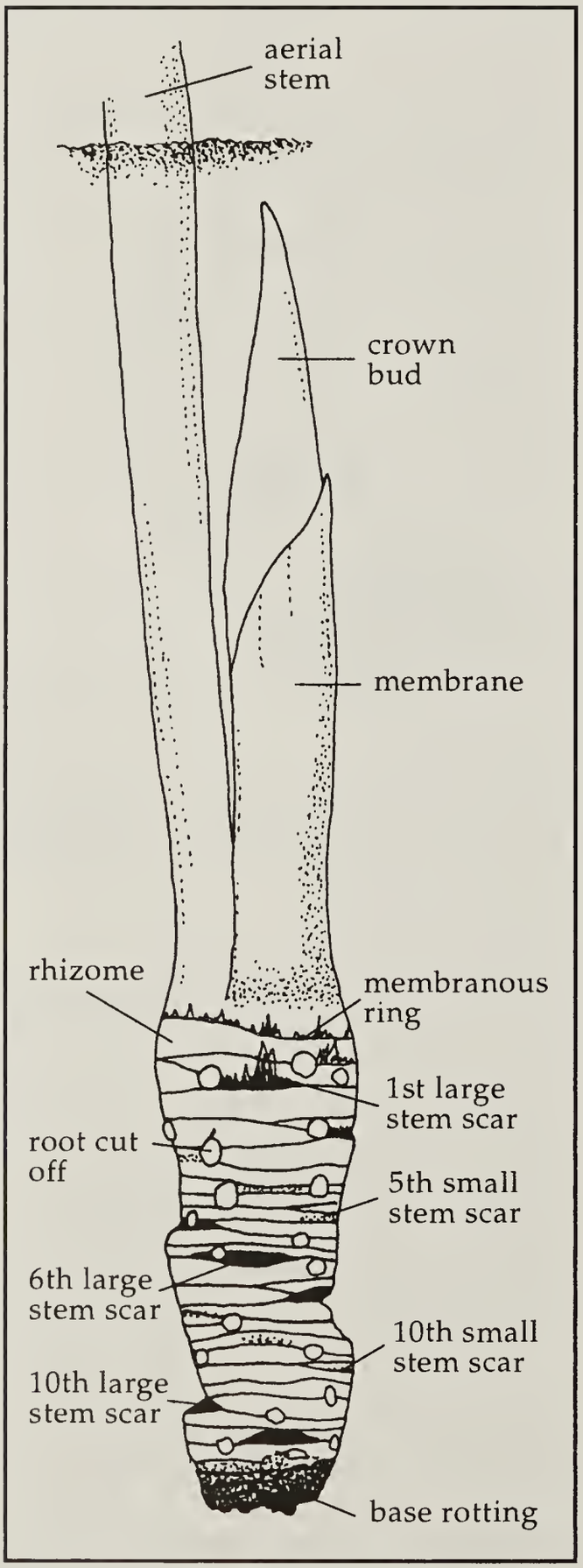

Figure 19a. Rhizome of a SF plant with stem scars in a spiral and a large crown bud, 21 September 2002.

On V1 plants the crown bud is narrow, with a stem and usually one leaf inside indicating that the plant will again be a V1 plant the following year. For example, on 26 August 2001, a V1 plant 5.7 cm tall had a single aerial leaf blade 3.2 cm long by 2.6 cm wide. The new shoot inside the crown bud consisted of a 2 mm long, white erect stem and an erect, curled, pale yellow leaf blade 4.5 mm long by about 4 mm wide when unrolled and flattened.

On V3 plants the crown bud may contain a young shoot and a smaller crown bud with pale yellow shoot primordium about 1 mm

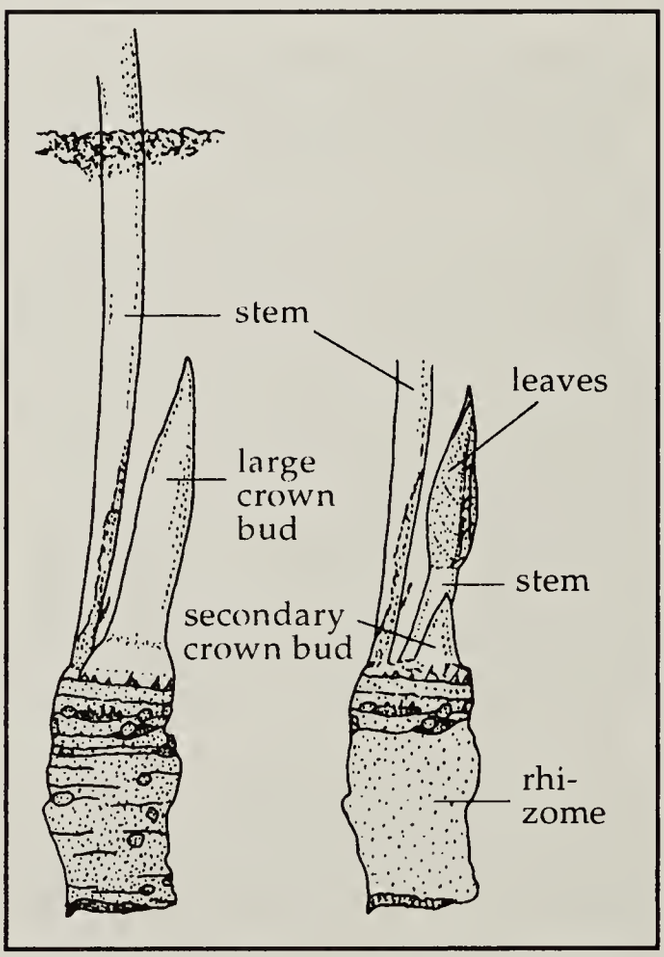

Figure 20. Crown bud of a V3 plant 31.5 cm tall, 30 August 2001. Crown bud membranes are intact (left) and removed (right) to reveal the new shoot (next year's plant) along with its crown bud at the base of the stem. Inside the leaves is a young flower with only three stamens.

long. A V3 plant 31.5 cm tall on 30 August 2001 had a crown bud 31 mm long. Inside was a shoot with three leaves that were 16 mm long and a flower with three stamens about 5 mm long and a pistil about 4 mm long (Fig. 20). This shoot would have emerged as a single-flower (SF) plant in 2002. Next to the shoot was a small, white secondary crown bud about 6 mm long. Always shorter than the stem of the main shoot, this bud will develop into a plant two years hence. A flower is usually absent in the crown bud of young, short V3 plants indicating they will repeat as a V3 plant the next year.

Large single-flower (SF) plants have crown buds which remind me of a set of stacking Chinese boxes. Careful dissection revealed at least three crown buds, each reduced in size. Staining may reveal more as tiny buds are clustered inside the 4-8 mm tall secondary crown bud adjacent to the stem of the main shoot. The secondary crown bud of the *T. cernuum* is present in the fall, over-winters and maintains its size (about 5 mm long) and position in the spring as the new aerial shoot emerges from the large crown bud. Beneath the collapsed membranes of the large active bud is the new crown bud. Bud formation is a continuous process atop the rhizome. In *Trillium kamtschaticum*, primordia form 3-10 years prior to aerial growth.[40 in 31]

The crown bud of a double-flower (DF) plant is located between the two current stems (Fig. 21). It may reach 5.0 cm in length with the pointed tip 5-10 mm above ground in September. Within the bud there are usually two large new shoots, indicating it will be a DF plant again next year (Figs. 21 - 21c). In five DFs examined, one crown bud had only one shoot, indicating double-flower (DF) plants can revert to a single-flower (SF) plant. How far in advance is this decision made by the Whip-poor-will-flower?

Ageing

The parts of the rhizome used to age trillium plants are stem scars and membranous rings.

Stem scars develop where the base of a stem breaks free from the outer surface of a rhizome. Stem scars are arranged in a spiral along the length of the rhizome (Fig. 22), a fact not mentioned in other *Trillium* papers. The spiral pattern may travel clockwise or counter-clockwise. A close look reveals two spirals of stem scars per rhizome, one of large scars and one of smaller ones, both visible in Fig. 22. Some very young vegetative (V1) plants have rhizomes without large scars but most have a least one. Young short V3 plant rhizomes and all older, large rhizomes have large scars.

Large scars are dark brown, shelf-like, crescent-shaped structures 1-6 mm long and up to 2.5 mm wide or deep. Five of them, about 72° apart, form a circle when the rhizome is viewed from above. The most recent large scar is near the top of the rhizome and usually has dark, erect veiny fragments remaining from the previous year's stem.

The second spiral of stem scars is less obvious. These scars are smaller and only slightly recessed as can be seen in Figs. 19 and 19a. The top or first scar is on the opposite side of the rhizome from the base of the growing stem and often indistinct. The lower scars are more apparent, especially when viewed through a dissecting microscope. My hypothesis is that each small scar in the secondary spiral is formed by the degeneration of a small crown bud and shoot inside the main large crown bud. A count of the smaller scars results in a number equal, or almost so, to the number of large scars, depending on the position of the lowermost scar in relation to the angled, decaying base of the rhizome.

Membranous rings are thin, dark brown horizontal lines around the outside of the rhizome (Figs. 19 and 19a). Generally about 1 mm apart, they range from 0.2-2.6 mm apart and are widely separated at the top of the rhizome. Membranous rings are formed from the basal remains of the white membranous covers of the main crown bud.

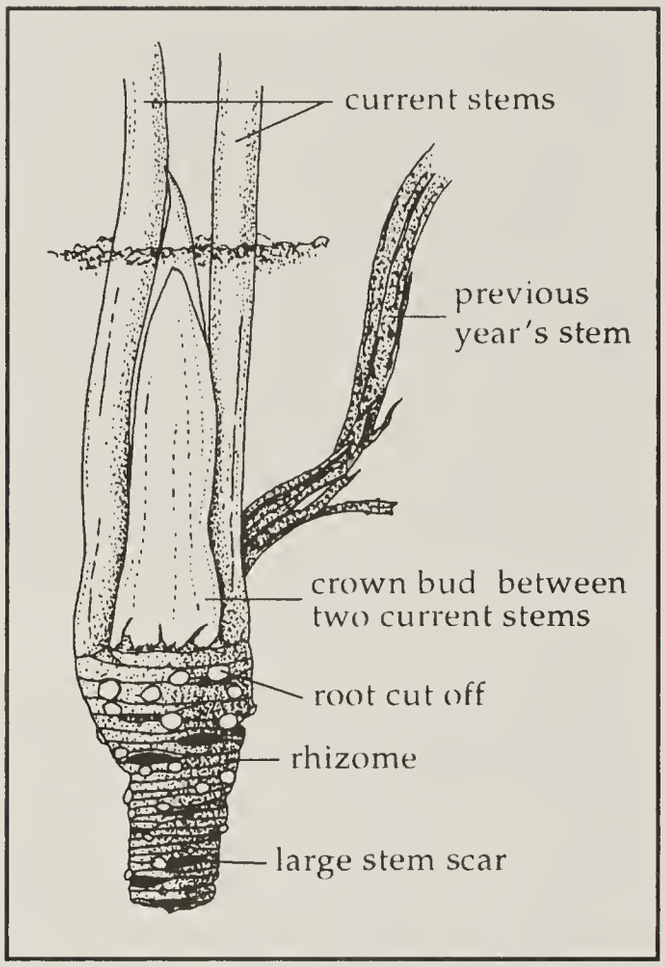

Figure 21. The crown bud (with membranes intact) of a DF plant, 13 September 2001.

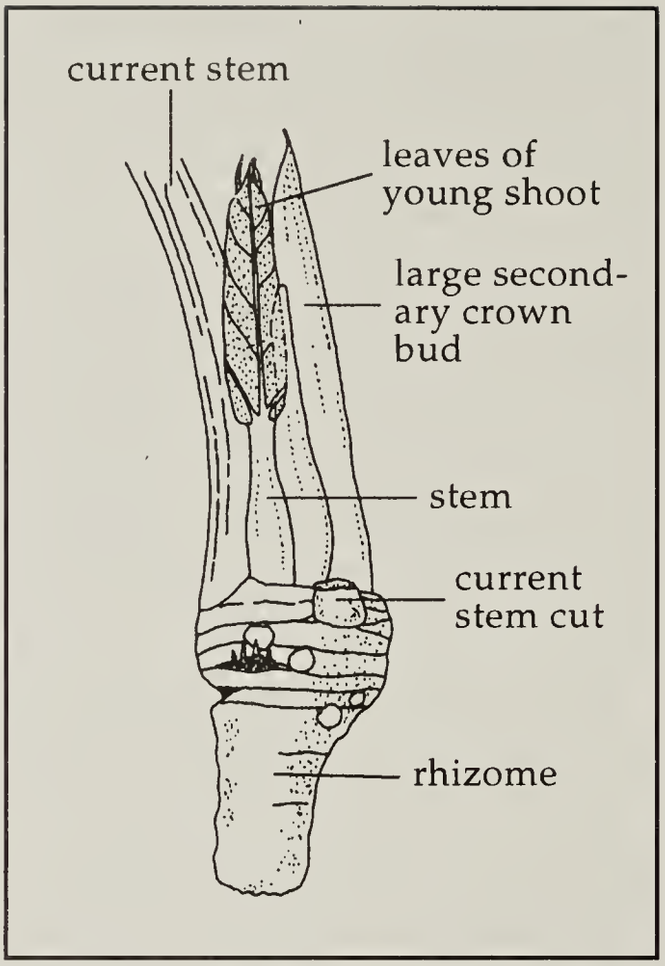

Figure 21a. Crown bud with membrane covers removed, revealing the large secondary crown bud. x 0.8

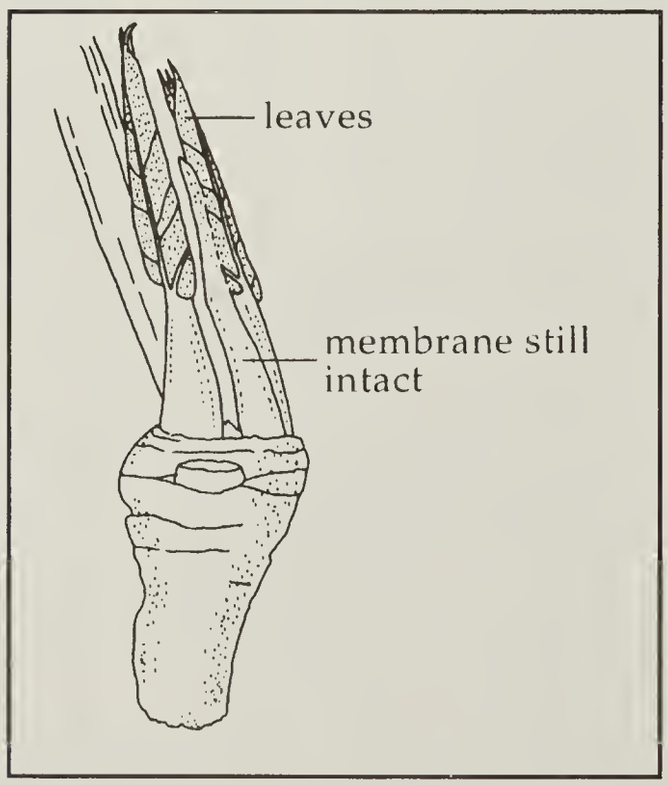

Figure 21b. Secondary crown bud membranes removed to show a second large, young shoot inside (next year's DF plant). x 0.8

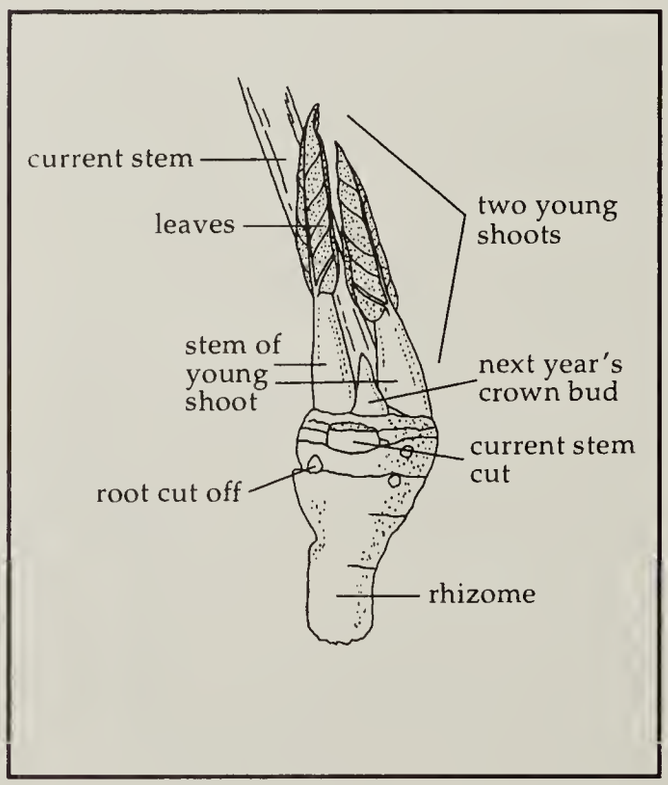

Figure 21c. Remaining membrane removed to reveal the small crown bud between the two new young shoots' stems.

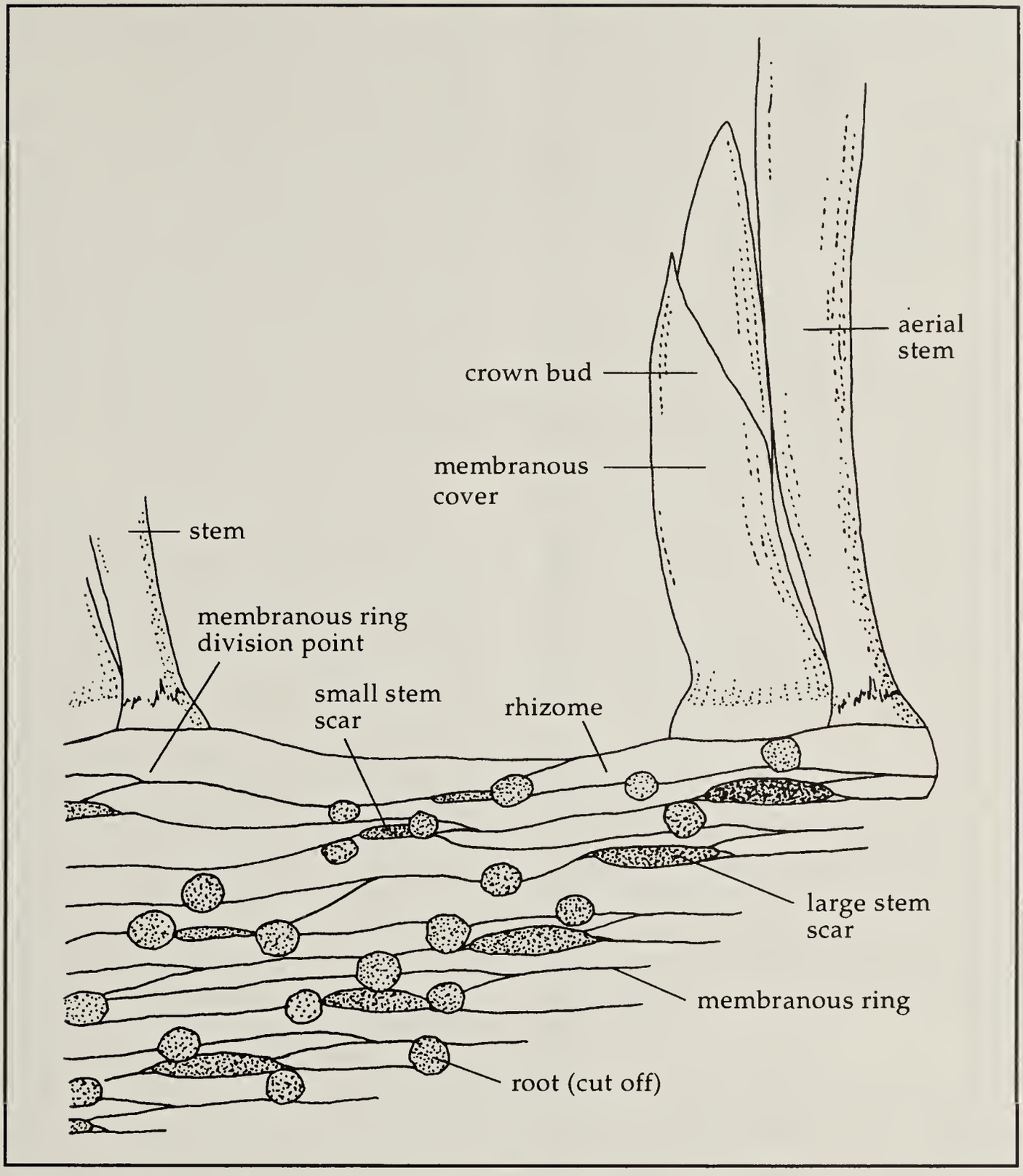

Figure 22. Diagrammatic drawing of a flattened rhizome of a single-flower plant (SF), 6 September 2001, showing the two spirals of stem scars, the membrane rings, stem base and crown bud. x 3

Within the membranous cover is the large shoot (next year's plant) and at its base a small, white, secondary crown bud with its own set of membranous covers (Fig. 20). There are two membranous rings between the top large stem scars (Fig. 22). The upper ring branches in two just before it enters a scar with the upper branch passing over the top of the scar and the other branch entering the scar. Two rings then continue to the next scar. Dividing the total number of rings on a rhizome by two generally results in a number equal to the number of stem scars in each spiral on a rhizome. On young rhizomes of V1 plants without stem scars, the rings form a continuous circle around the rhizome. For example, the vertical rhizome of one V1 plant was 10 mm long with no stem scars visible but 14 membranous rings gave it an age of seven years, eight if you include the first year of growth when no leaf is produced, or nine if you include the current stem.

There are three methods, described in the literature, for ageing *Trillium* species using rhizome features. The first method is to count the total number of dark, thin, membranous rings on the rhizome and assume one ring equals one year's growth.[8, 17] This method, I believe, as do others, overestimates the actual age of the plant.[31]

The second method, a variation of the first, is to count the number of membranous rings and divide that number by three. Three was used since this is the number of membranous covers of the crown bud surrounding the young Dwarf White Wakerobin shoot inside.[31] Another researcher counted the membranous rings but divided their number by two since he found two membranous covers on the crown bud of Blue Ridge Wakerobin, *Trillium stamineum*. Plants with one flower, aged in this manner, were 7-17 years old.[41]

The third method, and the most accurate, is to count the number of large stem scars on the rhizome. This method was used to estimate the minimum age for Dwarf White Wakerobin, assuming one stem scar is produced each year until the rhizome is large enough to generate two or more stems in one year.[31]

All three ageing methods have a shortfall because, as the end of the rhizome decomposes, both rings and scars are lost to the soil. Thus these methods can only provide a minimum age. The rhizome begins to decompose quite early in a Whip-poor-will-flower's life. Seven of the ten one-leaf vegetative (V1) plants excavated in July 2002 in Winnipeg had a decaying rhizome. All ten V3 plants had a rotting base on their rhizomes. All flowering plants, ten single-flower (SF) and ten double- flower (DF), exhibited a decomposing rhizome.

To make the estimates used in this study, I ignored the number of membranous covers around the crown bud. Instead I counted the number of membranous rings between large scars at the top of the rhizome and came up with two. Counting the number of complete membranous rings is problematic since the rings cannot be traced in a complete circle around a rhizome with large stem scars (as shown in Fig. 22), a fact not mentioned by other researchers. However, once counted, division by two gives a number equal or close to the number of stem scars in each spiral and this was taken to be the age of the plant. The largest *T. cernuum* plant had 32 rings and 16 scars or years of age. I would estimate *T. cernuum* plants, especially doubles, are probably 20-30 years of age.

I used the ages determined in this way to see if stem length and leaf blade width correlate with plant age. In July and early August 2002, before the fruit was fully ripe, I dug out Whip-poor-will-flower rhizomes from ten plants in each of four categories: V1, V3, SF and DF. The number of large stem scars was plotted against stem length (Fig. 23) and leaf blade width (Fig. 24). Although in general, taller plants have wider leaves and are older as the upward trends of the two graphs indicate, neither the stem length nor the blade width were accurate indicators of plant age. A stem about 25 cm tall could have a rhizome with 7-13 large stem scars and a leaf blade about 10 cm wide could have a rhizome with 7-15 large stem scars. A rhizome with 7 large stem scars may appear as a V1, V3, SF or even a DF plant with a height ranging from 7-26.2 cm. An older plant with 13 large stem scars might surface as a V3, SF, or a DF plant 25.5- 46 cm tall. A similar situation is found with the leaf width.

It was perplexing to discover that some vegetative, one-leaf (V1) plants had a rhizome full of large stem scars while others of about the same length had none or only a few large scars. The lack of stem scars on some young rhizomes could indicate the lack of an aerial stem for one or more years. In Large-flower Wakerobin, some rhizomes do not produce aerial parts each year, or they produce a large vegetative plant. This is

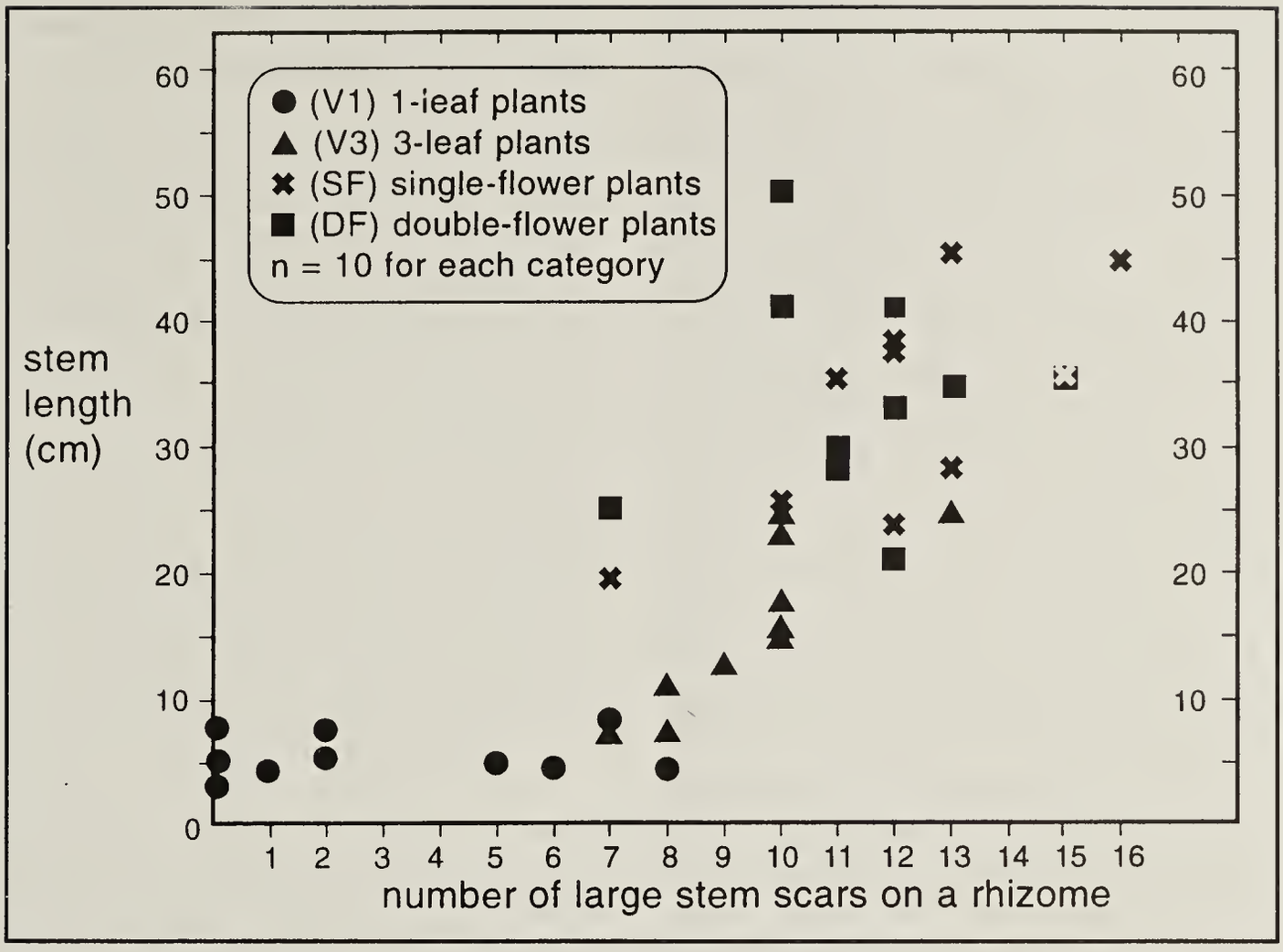

***Figure 23. Relationship between stem length and number of large stem scars on rhizomes in four categories of plants of* Trillium cernuum.**

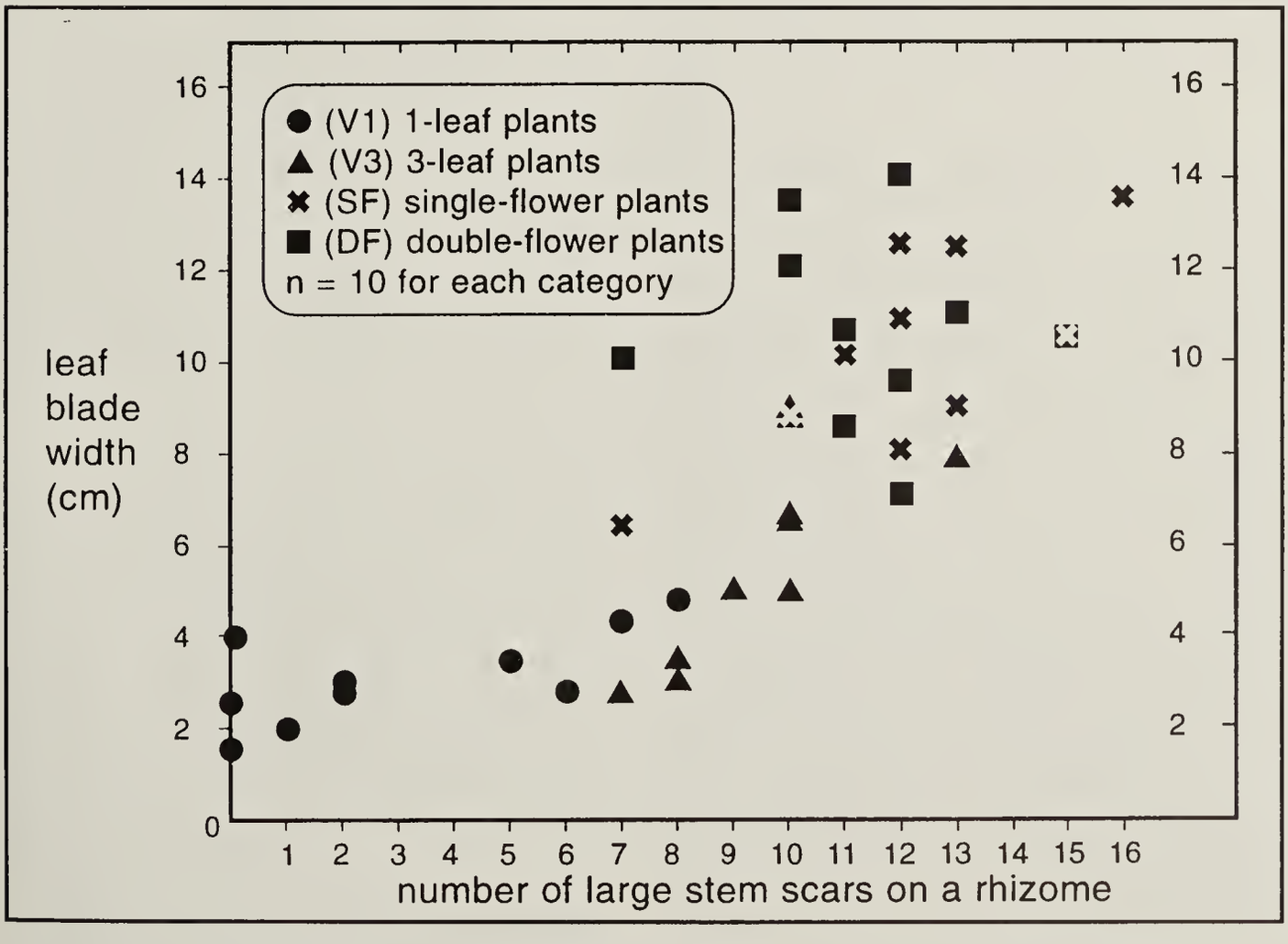

***Figure 24. Relationship between leaf blade width and number of large stem scars on rhizomes in four categories of plants of* Trillium cernuum.**

probably due to poor storage performance by a plant the previous year.[17] When no aerial stems are produced, several of these early years are lost in the counting of scars on older rhizomes due to their lack of early stem scar production. Also, the early scars are the first to be lost as the end of the growing rhizome disintegrates in the soil. More attention to rhizomes in the *Trillium* species is necessary if we are to begin to understand growth adjustments of this variable, long-lived perennial.

Plant associates

In my study, the mean distance from one *T. cernuum* plant to the next *T. cernuum* (all categories, n=159) was 25.7 cm (1.0-92.4). For single-flower (SF) plants (n=117) the nearest *T. cernuum* neighbour was a mean of 31.0 cm away. The mean distance and range from the nearest SF are, by category: V1 (7%) at a mean distance of 45.2 cm (11.1-195.0) from a SF plant; V3 (69%) at 29.2 cm (0.2-160.0); SF (23%) at 32.3 cm (5.5-133.5), and DF (1%) at 31.7 cm. The mean distance from a *T. cernuum* to a non-trillium plant (n=159) within the quadrats was 13.0 cm (1.0-57.5).

Twelve species of non-trillium plants were identified in the quadrats. In order of decreasing abundance they are Starry False Solomon's-seal, *Maianthemum stellatum* 58 (37%); European Buckthorn, *Rhamnus cathartica* 56 (36%); Choke cherry, *Prunus virginiana* 18 (12%); False Lily-of-the-valley, *Maianthemum canadense* 8 (5%); Thicket-creeper, *Parthenocissus vitacea* 4 (2.5%); Green Ash (dead), *Fraxinus pennsylvanica* 3 (2%); Swamp Red Currant, *Ribes triste* 2 (1.3%); King Solomon's Seal, *Polygonatum biflorum* 2 (1.3%); Wild Sarsaparila, *Aralia nudicaulis* 1 (0.6%); Western Poison Ivy, *Toxicodendron rydbergii* 1 (0.6%); American Elm, *Ulmus americana* 1 (0.6%): Ash-leaf Maple, *Acer negundo* 1 (0.6%); and an unknown deciduous shrub 1 (0.6%). The first three species account for 85% of the close encounters of an alternate kind for *T. cernuum* in the quadrats.

In the eight quadrats the shrub European Buckthorn had a mean distance from a *T. cernuum* of 10.3 cm (1-33.3). The mean buckthorn height was 102 cm (4 to about 600). However, when shrubs taller than 1 m are excluded (n=10), the mean height is 13.1 cm (4-50). During this study it was apparent that hundreds of small European Buckthorn shrubs were growing in this forest though the taller shrubs were usually dead due to a buckthorn eradication program.

Predation by deer

As one of the few sources of fresh green growth on the forest floor in May and early

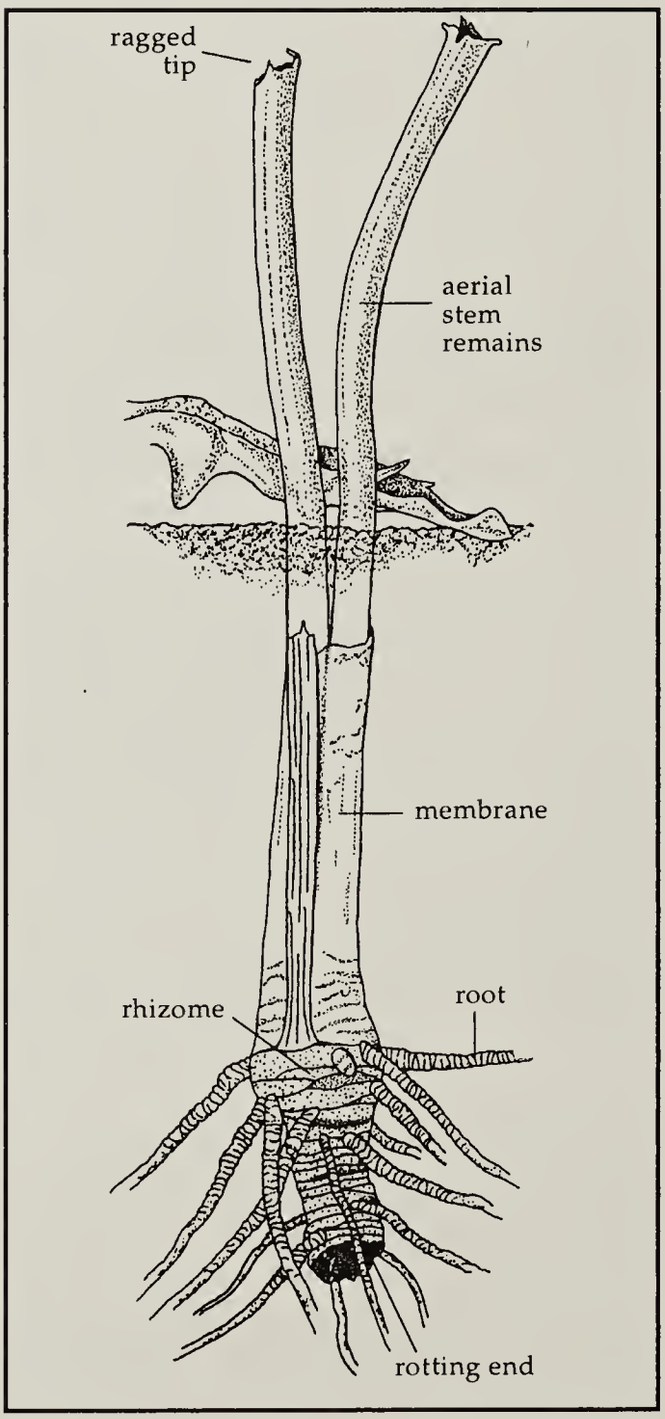

Figure 25. A double-stem* Trillium cernuum *browsed by a White-tailed Deer, 16 May 2001.

June, *T. cernuum* is an attractive food for White-tailed Deer which eat the upper plant leaving about half or more of the lower stem with a ragged tip (Fig. 25). Browsing by deer (not observed) occurs mainly in mid- to late May as the plants are about to flower, or are flowering. Starry False Solomon's-seal are also readily eaten by deer in spring.

T. cernuum stems that remain after browsing (n=89) had a mean length of 18.0 cm (4.6-37.5) with a mean basal width of 5.0 mm (2.5-7.7). These plants were outside the quadrats and mostly in the central western part of the population. I would estimate 100-200 stems (<1% of the total population) were consumed by deer in the spring each year.

In Illinois, White-tailed Deer seemed to preferentially browse taller plants of Large-flower Wakerobin. Annual browsing of the same plants over several years causes a decline in their height and reproductive ability since the leaves and flowers are consumed each year early in the spring and no regrowth takes place.[2]

In the Winnipeg population, the remaining browsed stem height for DFs (n=46) was 17.3 cm (5.1-37.5) compared to 33.9 cm (23.0-46.6) on mature (n=128) unbrowsed doubles elsewhere. The 17.3 cm height is biased toward the low end since the plants were measured from 13-24 May 2001. Browsing by deer at this time was on plants not fully grown.

Of the 89 browsed stems I measured, 46 stems (52%) belonged to 23 doubles (DV and DF). Seventeen (74%) of these 23 doubles had both stems eaten; only 6 (26%) of the doubles had one stem eaten with the uneaten stem bearing a flower. In my selective search for browsed plants, a bias was due to the ease of visually locating the thick remains of an eaten double compared to a single thin vegetative plant's browsed stem.

For browsed plants (n=66), the mean distance to the nearest *T. cernuum* was 11.6 cm (2.0-30.6). This distance is less than half the mean distance for the categories recorded within quadrats (where no doubles were present) of 25.7 cm (1.0 - 92.4) indicating deer browse where the plants are close together. Three plant categories accounted for 96% of the nearest neighbour to browsed stems: a single browsed stem (n=30, 44%) at a mean distance of 11.6 cm; vegetative (V3) plants (n=22, 32%) at a mean distance of 15.0 cm; and doubles (n=14, 20%) at a mean distance of 6.1 cm. Since about half of the browsed Whip-poor-will-flowers were doubles and the closest neighbours were also doubles, the data suggest deer tend to browse where the large doubles grow.

Unbrowsed doubles (DF and DV) located systematically had a nearest *T. cernuum* neighbour mean distance of 25.4 cm (n=33) which is close to the mean distance of 25.7 cm for the quadrat plants where no doubles were present. As well, 9 (27%) of unbrowsed doubles had another double (5 DF and 4 DV) as its nearest neighbour and their mean distance was only 16.5 cm. By comparison, single-stem vegetative (V3) plants were a mean of 29.4 cm (n=24, 73%) from the doubles, which is about twice that recorded for the browsed doubles above.

Other herbivores

On 13 May 2001, I watched a Cottontail Rabbit eat a *T. cernuum* (not reported previously as a predator of trilliums). The rabbit nipped the stem off at its base and proceeded to eat the stem toward the leaves and flower bud. One rabbit was seen occasionally throughout the summer in the trillium population. Near its resting place under shrubbery in 2002, most of the trillium plants for about a 5 m radius were noticeably absent compared to the previous year indicating heavy predation in that area. No estimate of the number of *T. cernuum* eaten by the rabbit was possible since the stem bases are not readily visible. The cottontail's range, like that of White-tailed Deer, overlaps much of the range of the Whip-poor-will-flower.[12]

On 18 August 2002, as I was measuring

fruit sizes of double-flower (DF) plants, two ripe fruit were on the ground. About one-third of one berry was eaten and seeds were scattered around it. The predation was likely by a small mammal. Since I never observed mice in the open woods, I suspect American Red Squirrels or Eastern Chipmunks were eating the elaiosomes. The scattered seeds had only parts of their elaiosomes still attached. No ants attended the exposed berry. In Indiana, rodents (unspecified spp.) took fewer than 5% of Dwarf White Wakerobin fruit.[42]

On 25 August 2002, twelve ripe fruit still attached to SF plants were observed (through binoculars) from a distance of 1 to 7 m away, for an hour in the late sunny morning. No insect or mammalian predation was recorded. Both an American Red Squirrel and an Eastern Chipmunk were in the area but appeared not to notice the ripe berries. A week later all the fruit had fallen from the plants. No berries were found on the floor near the plants or elsewhere. Perhaps after the fruit falls it is discovered and carried away by squirrels and chipmunks.

Invertebrates

T. cernuum pistils were almost without insect damage. Only one double-flower (DF) plant had both pistils chewed. None of the ovaries or fruit I opened had larvae inside. For Stinking-benjamin, larvae of two species of *Clepsis* moths often infested the flowers in New Hampshire.[8]

A grey slug (*Arion* spp., Family Arionidae) about 2 cm long was observed (probably eating the elaiosomes) half inside one ripe fallen *T. cernuum* berry (Fig. 26) on 17 August 2001 and again on 25 August 2002. Slime trails were occasionally noticed on fruit still attached to an erect plant. Millipedes, too young to identify, also feed inside ripe decaying berries on the ground. In northern California, 20 cm long Banana Slugs, *Ariolimax columbianus*, and snails, *Vespericola megasoma*, feed on elaiosomes of *T. ovatum*, Western Wakerobin.[28]

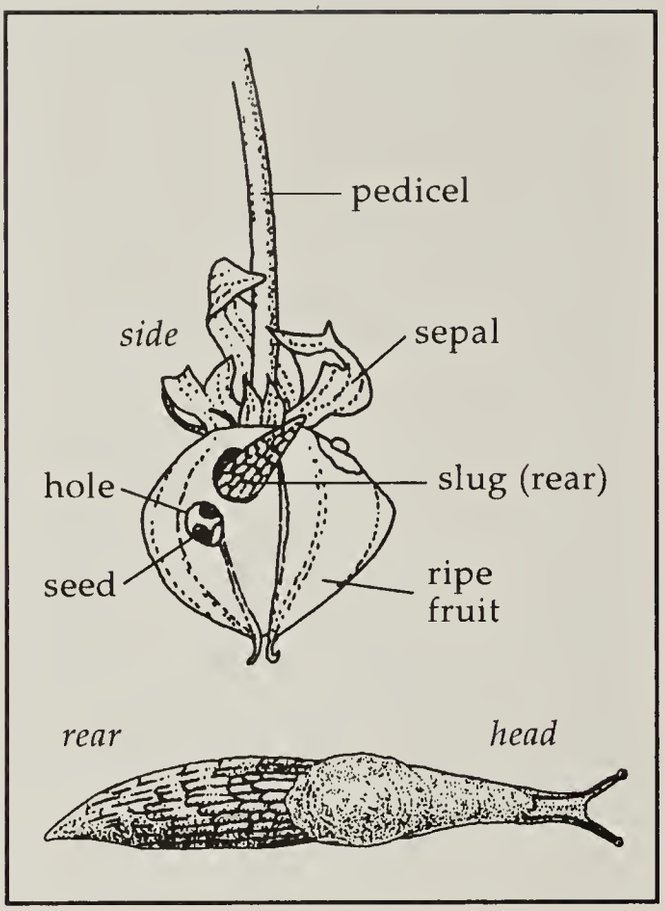

Figure 26. A grey woodland slug (*Arion sp.*) feeding on elaisosomes through a hole in a fallen ripe fruit of* Trillium cernuum *(above). x 1. Dorsal view of slug (below). x 2.5

Ant dispersal

The dispersal of seeds of *Trillium* species by ants has been known for decades.[13,14] Dispersal tends to reduce competition between seedlings and increases their growth and survival.[19] The seed itself is not eaten, only discarded, but the large, lipid-rich elaiosome attached to each seed is an attractive food source (Fig. 10). The fatty acid component of the lipids has been analysed in the elaiosome and seed for the pedicillate species in North America.[43] The chemical composition of elaiosomes varies with species but why some are attractive to some ants remains unclear.[25]

My brief experiment on ant dispersal began at 1530h on 21 July 2001. I tore open a nearly ripe fruit and scattered about 15 seeds, with elaiosomes attached, directly onto an active colony of Common Carpenter Ants.[46] Seeds were quickly discovered, picked up and carried away from the 40 cm wide earthen colony. For (n=8) trips the mean

distance each ant carried a seed was 1.9 m (0.4 - 3.5). The open forest floor made it easy to visually follow the pale yellow elaiosome against the dark earth and scant debris. Ants made no attempt to remove or eat the elaiosome. Away from the nest the seed was dropped and the ant headed back to the colony. Centrally located along a natural path, this was the only ant colony found in the Whip-poor-will-flower population. Ants were not observed elsewhere in the forest during May through September, either on the ground, vegetation, or me. By early July there was little surface activity visible in the colony, although the carpenter ants were busy underground. By the time fruit ripened in mid-August and was about to fall, the ant colony appeared abandoned. Three other colonies about 150 m away on the edge of a nearby woods were also abandoned in early August. No ants were observed at or near any fallen fruit, and are not considered a source of seed dispersal in this *T. cernuum* population.

Seed dissemination by ants has been reported in Ohio for Dwarf White Wakerobin, in northern California for Western Wakerobin, and in New York State for Stinking-benjamin, Large-flower Wakerobin, (*T. grandiflorum*) and Painted Wakerobin, (*T. undulatum*).[31, 28, 16] In New York, at least four species of ants were involved including the Common Carpenter Ant, *Camponotus pennslyvanicus,* which ignored the seeds.[16]

Once an ant removes a seed and elaiosome from the fallen berry, it is carried away to an underground nest. Sometimes the elaiosome is quickly removed leaving the discarded seed close to the parent plant. *Trillium* seeds in Japan were transported a mean distance of 60 cm (maximum 3.3 m) by five ant species.[32] In Australia, the mean carry was 2.1 m for three ant species.[1] Overall, seed dispersal is dependent on the number of ants present since chance encounters are an important factor as is the distance to the ant's nest, i.e., how much work the ant must do and over what kind of terrain.[41]

In south-western Oregon, over four summers, ants were never observed carrying Western Wakerobin seeds in the Siskiyou Mountains. Instead Yellow Jackets, *Vespula vulgaris*, transported seeds with elaiosomes to distances > 30 m from the fruit.[23] To the east, Yellow Jackets, *V. flavopolosa* and *V. maculifrons*, transported elaiosome-bearing seeds of Little-sweet-Betsy, (*T. cuneatum*), Bashful Wakerobin, (*T. catesbaei*), and Painted Wakerobin in the Blue Ridge Mountains of North and South Carolina.[47] A wasp would grasp the seed/elaiosome using its six legs and either fly out of sight (> 20 m), or alight on a nearby shrub, chew off the elaiosome, let the seed fall to the forest floor and fly away with the elaiosome. In the latter case, the seeds without their elaiosomes were recovered at a mean distance of 1.4 m (0.1 - 2.6) from the parent plant. Although Yellow Jackets, *Vespa germanica*, occur in my study area in August, I did not observe any trillium seed dispersal by wasps.

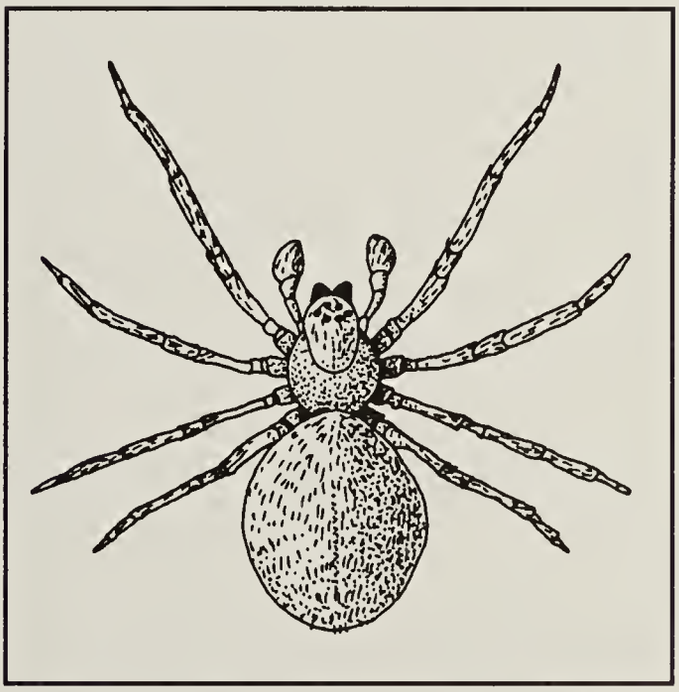

Figure 27. A grey spider often found among the wilted petals and green sepals of the Whip-poor-will-flower in August and September. x 10

When collecting ripe fruit during August of both years, it became apparent that a grey spider, about 5 mm long (Fig. 27), resided at the base of some fruit among the sepals and petal remains. Strands of webbing around the fruit base held various dead insects 2-3

mm long. Several spiders were collected in August but their immaturity prevented identification.

Acknowledgments

I would like to thank Anne Adkins for the use of her dissecting microscope which permitted small plant parts to acquire some detail when drawn and described. Richard Staniforth provided ideas on quadrat layout and a sheet of random numbers. Bruce Ford alerted me to the book, *Trilliums*, by the Cases. Mark Elliot provided 100 plastic markers which were used to re-locate plants the second year. Karin Newman and two anonymous reviewers commented on the manuscript. David Scott provided wooden dowels which were used to mark the boundaries of the quadrats. Howard Clase in Newfoundland clarified the range of the Whip-poor-will-flower in Labrador. Staff at the National Museum of Nature in Ottawa, Ontario identified the black ant and Yellow Jacket but had no specific suggestion for the immature grey slug, grey spider or milliped. I am equally grateful to botanists and curators associated with these herbaria: ACAD, BH, BKL, CANM, CM, DAO, EIU, GLFC, GMNP, HAM, IND, ISC, LKHD, MAINE, MIL, MMNM, MT, MU, MVSC, NBM, NA, NCU, ND, NEBC, NSPM, NYS, PH, UCHT, ULF, UNB, UNCC, VPI, WAT, WET, WIN, WVA, WVA, and WVW. They responded to my letter of inquiry on *T. cernuum* in their area and provided information about its range from their herbarium or local reference books. The Manitoba Naturalists Society permitted me to prepare this manuscript on their computer. This two-year study was initiated and financed by the author.

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INSECTS

THE DRAGONFLIES OF MANITOBA: AN UPDATED SPECIES LIST

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Figure 1. Common Whitetail, **Libellula lydia** ***David P. Hughes***

Dragonflies are some of our most familiar insects and the perfect animals for a naturalist to enjoy watching. (In this article the word dragonfly refers to the entire order Odonata, including those insects sometimes referred to as damselflies.) Their relatively large size, daytime habits and accessibility make dragonflies easy to observe. From the comfort of a lakeside deck chair, on a hot July afternoon, one can observe mature larvae crawling from the water and emerging into adults, and adult dragonflies patrolling and defending territories, courting, mating and even laying eggs. In spite of this, relatively little work has been done to determine the species present in various jurisdictions in Canada, including Manitoba.

We are all indebted to the late Edmund M. Walker whose work on the dragonflies of Canada and Alaska resulted in many published articles and a valuable set of books, the latter completed by his colleague Philip Corbet.[6,7,8] Walker visited Manitoba in 1913, 1921 and 1931. His visits were short and limited by such transportation as was available at the time. Even so, his contacts with local collectors such as Norman Criddle and J.B. Wallis allowed him to publish, in 1933, an account of 63 species for Manitoba.[4] Walker subsequently published additional notes in 1941.[5] Manitoba was

included in general insect surveys such as the Northern Insect Survey, the results of which were included in "The Odonata of Canada and Alaska".[6,7,8] The next published Manitoba list was that of John Conroy and James Kuhn in conjunction with their study of water mites, the larvae of which parasitize dragonflies.[2] Some collecting of dragonflies has occurred over the years and specimens have been deposited at the Manitoba Museum, the J.B. Wallis Collection at the University of Manitoba and elsewhere, but an update to the provincial species list seemed long overdue.

This report is the result of a study that began with the Manitoba Dragonfly Survey, a monitoring network established (by Jim Duncan) in 1999. Volunteers collected specimens for the survey from many sites in southern Manitoba and from The Pas, Flin Flon, Thompson and Churchill. The personal collection of Marjorie Hughes, which was begun in 1978, was incorporated into this study. Altogether, more than 1000 specimens have been identified and catalogued by the Manitoba Dragonfly Survey.

Recently, dragonflies were ranked according to their rarity in jurisdictions across Canada by the affiliated members of the National General Status Working Group under the auspices of the Canadian Endangered Species Conservation Council.[9] A meeting of dragonfly experts from across Canada was held in Winnipeg October 9, 2002 to establish draft ranks for all species present in Canada. Ranking of species is helpful in prioritizing conservation efforts.

The present Manitoba list includes 95 species of dragonflies from nine families. New records are marked with an asterisk (*). Abbreviations are used in the text for directions (n north, se southeast, cent for central etc.), col. for collector, MM for Manitoba Museum, CDC for Conservation Data Centre, Man for Manitoba and Prov. for Provincial. The nomenclature is based on the list of scientific and common names adopted by the Dragonfly Society of the Americas.[3] After the name, each species is given a category of common, uncommon, rare or status uncertain. These are included to give observers a rough idea of whether they are likely or unlikely to encounter this species. A common species would be known from over 100 sites in the province and have a population size of over 10,000 individuals. A species listed as uncommon is known from about 21 to 100 occurrences with populations estimated at 3000 to 10,000 individuals. A rare species is known from less than 20 sites and populations are estimated at less than 3000 individuals. For several species, not enough information is known to make this assessment, so the category is given as "status uncertain." Some species are listed as accidental if the occurrence is well outside their normal range.

A species list should always be considered as a work in progress. As our knowledge of the dragonfly fauna increases, changes to this list will certainly be made. More collecting is needed in many geographic regions, especially the north, and in various habitat types. Plans are already underway for a comprehensive illustrated book on the dragonflies of Manitoba.

DAMSELFLIES (Suborder Zygoptera)

Jewelwings (Family Calopterygidae)

Calopteryx aequabilis Say - RIVER JEWELWING - common, s Man n to Grand Rapids.

C. maculata (Beauvois) - EBONY JEWELWING - rare (edge of range), extreme se Man, recorded once from Waugh.

Spreadwings (Family Lestidae)

Lestes congener Hagen - SPOTTED SPREADWING - uncommon, s Man n to Grindstone Prov. Park.

L. disjunctus Selys - COMMON SPREADWING - common, s and cent Man n to Gillam.

L. dryas Kirby - EMERALD SPREADWING - common, s Man n to The Pas.

L. forcipatus Rambur - SWEETFLAG SPREADWING - status uncertain, s Man (this species is morphologically very similar to *L. disjunctus*, which leads to problems with identification).

L. inaequalis Walsh* - ELEGANT SPREADWING* - rare, e of Lee River 18-VII-1999 col. Ray Tuokko (1♂ CDC collection); Lyons Lake 16-VII-2001 col. Lance Barber (1♀ CDC collection).

L. rectangularis Say - SLENDER SPREADWING - uncommon, se Man to Winnipeg and Bird Lake.

L. unguiculatus Hagen - LYRE-TIPPED SPREADWING - common, s Man n to St. Laurent.

Pond Damsels (Family Coenagrionidae)

Amphiagrion saucium (Burmeister) - EASTERN RED DAMSEL - rare, Treesbank (Aweme), col. E. Criddle VI-1911 (J.B. Wallis Collection); bog near Gull Lake 8 VII 2000, col. J.R. Duncan (2♂ 1♀, CDC collection); Long Point (52° 55' N 98° 53' W) 20 VII 2000 col. Terence Smith (1♂ 1♀ CDC collection).

Chromagrion conditum (Selys) - AURORA DAMSEL - rare (edge of range), Ft.Whyte Centre, Winnipeg.

Coenagrion angulatum Walker - PRAIRIE BLUET - uncommon, sw Man, n to The Pas.

C. interrogatum (Selys) - SUBARCTIC BLUET - status uncertain, n Man: Long Point, The Pas, Wabowden.

C. resolutum (Selys) - TAIGA BLUET - common, records widespread from Emerson to Churchill.

Enallagma boreale Selys - BOREAL BLUET - common, s and cent Man to York Factory.

E. carunculatum Morse - TULE BLUET - uncommon, se Man to Winnipeg and Bird Lake.

E. civile (Hagen) - FAMILIAR BLUET - common, Red River Valley n to Victoria Beach and e to Sandilands Prov. Forest.

E. clausum Morse - ALKALI BLUET - uncommon but abundant in scattered localities, sw Man n to Victoria Beach and The Pas.

E. cyathigerum (Charpentier) - NORTHERN BLUET - common, s and cent Man n to Gillam.

E. ebrium (Hagen) - MARSH BLUET - common, s Man n to The Pas.

E. hageni (Walsh) - HAGEN'S BLUET - common, s Man n to The Pas.

Ischnura damula Calvert - PLAINS FORKTAIL - rare, Ft. Whyte Centre, Victoria Beach and Whiteshell Prov. Park.

I. perparva Selys - WESTERN FORKTAIL - rare, Ft. Whyte Centre, Winnipeg Beach.

I. posita (Hagen) - FRAGILE FORKTAIL - status uncertain, one specimen from Ft.Whyte Centre, 1976.[2]

I. verticalis (Say) - EASTERN FORKTAIL - fairly common, se Man to Winnipeg and Victoria Beach.

Nehalennia irene (Hagen) - SEDGE SPRITE - common, s and cent Man n to The Pas.

DRAGONFLIES (Suborder Anisoptera)

Darners (Family Aeshnidae)

Aeshna canadensis Walker - CANADA DARNER - common, s and cent Man n to Wabowden.

A. constricta Say - LANCE-TIPPED DARNER - common, s Man n to Dauphin.

A. eremita Scudder - LAKE DARNER - common, s and cent Man n to York Factory.
A. interrupta Walker - VARIABLE DARNER - common throughout Man n to about 56°N.
A. juncea (Linnaeus) - SEDGE DARNER - status uncertain, from se corner of Man n to Churchill.
A. septentrionalis Burmeister - AZURE DARNER - status uncertain, extreme n along the Hudson Bay coastline.
A. sitchensis Hagen - ZIGZAG DARNER - common, from Tolstoi and Star Lake n to Churchill.
A. subarctica Walker - SUBARCTIC DARNER - uncommon, records from Star Lake to The Pas.
A. tuberculifera Walker* - BLACK-TIPPED DARNER* - rare, Narcisse (pond) VI-1993 col. "TAC/TCG" (1♀ J.B. Wallis Collection); Star Lake, (Whiteshell Prov. Park) 29-VII-2001 col. D.R.Collicutt (1♂ CDC collection).
A. umbrosa Walker - SHADOW DARNER - common, widespread in s and cent Man to Churchill.
Anax junius (Drury) - COMMON GREEN DARNER - common throughout s Man n to about 50°N.
Basiaeschna janata (Say) - SPRINGTIME DARNER - uncommon in extreme se corner of Man, Whiteshell Prov. Park and Pinawa.
Boyeria vinosa (Say) - FAWN DARNER - uncommon, occurs only in extreme se corner of Man, all records are within Whiteshell Prov. Park.

Clubtails (Family Gomphidae)
Arigomphus cornutus (Tough) - HORNED CLUBTAIL - uncommon, se Man and w to Winnipeg, Red River and La Salle River.
Dromogomphus spinosus Selys* - BLACK-SHOULDERED SPINYLEG* - rare (edge of range), 1 km n of Oak Hammock Marsh 9-VIII-1992 (1♂1♀) col. J. Diawol; Sandilands Prov. Forest 2 km e of Marchand 3-VII-1993 (1♂) col. J. Diawol (specimens in J.B. Wallis Collection).
Gomphus exilis Selys - LANCET CLUBTAIL - uncommon, se Man from Lyons Lake to Berens River.
G. externus (Hagen in Selys) - PLAINS CLUBTAIL - uncommon but may be abundant in scattered localities, Red River valley n to Winnipeg Beach, Assiniboine River w to Treesbank.
G. fraternus (Say) - MIDLAND CLUBTAIL - fairly common along Winnipeg River and Lake Winnipeg n to Berens River. Manitoba also has a distinctive smaller pale type of this species which Walker recognized as subspecies *G. fraternus manitobanus*.[7] It was found on the Red River at Winnipeg and on the Assiniboine River at Treesbank.
G. graslinellus Walsh - PRONGHORN CLUBTAIL - rare, across s Man to about 50°10' N.
G. spicatus Hagen in Selys - DUSKY CLUBTAIL - rare to uncommon due to limited range, extreme se Man, Whiteshell and Nopiming Prov. Parks.
G. vastus (Walsh)* - COBRA CLUBTAIL* - rare, Jessica Lake, Whiteshell Prov. Park. 6-VII-1953 col. R.D.Bird (2♀ J.B. Wallis collection); Silver Falls (Winnipeg River) 13-VII-2000 col. John Markert (2♀ CDC collection).
Hagenius brevistylus Selys - DRAGONHUNTER - common, se Man n to Berens River.
Ophiogomphus colubrinus Selys - BOREAL SNAKETAIL - fairly common, from se Man to Gillam.
O. rupinsulensis (Walsh) - RUSTY SNAKETAIL - uncommon, across s Man n to about 50°10' N.
Stylurus notatus (Rambur) - ELUSIVE CLUBTAIL - rare, s Man n to The Pas.

Spiketails (Family Cordulegastridae)

Cordulegaster maculata Selys* - TWIN-SPOTTED SPIKETAIL* - rare (edge of range), se Man, Sandilands Prov. Forest 17-VI-1989 (1♂) col. R.N. Brandt; 7-VI-1990 (1♀) col. T.D. Galloway/ "DCH/ACT". An exuvia from Falcon Lake 23-VI-1991 col. T.D. Galloway (all specimens in J.B. Wallis Collection).

Cruisers (Family Macromiidae)

Didymops transversa (Say)* - STREAM CRUISER* - uncommon, limited distribution in se Man, collected from May 22 to June 29 by several collectors (M.L. Hughes, D.R. Collicutt, G. Vidal and L. Barber - Whiteshell and Nopiming Prov. Parks (11♂, 4♀ specimens in CDC and MM collections).

Macromia illinoiensis Walsh - ILLINOIS RIVER CRUISER - rare to uncommon due to limited distribution, se Man n to Berens River.

Emeralds (Family Corduliidae)

Cordulia shurtleffii Scudder - AMERICAN EMERALD - common throughout Man.

Dorocordulia libera (Selys)* - RACKET TAILED EMERALD* - uncommon, Hansen Creek 11-VII-1978 col. T.D. Galloway, (J.B. Wallis Collection); Winnipeg, 9-VI-2001 col. H. Mueller; Star Lake, 4-VI-2000 col. D.R. Collicutt; Lyons Lake 8-VII-2001 col. L. Barber; w of Pinawa 17-VI-1999 col. J.R. Duncan; Rabbit River; Nopiming Prov. Park, 22-VI-2001 col. G. Vidal (3♂, 6♀, specimens in CDC collection).

Epitheca canis (McLachlan) - BEAVERPOND BASKETTAIL - uncommon, Whiteshell Prov. Park and Sandilands Forest Reserve, also Riding Mountain National Park, Dauphin and Swan River.

Epitheca cynosura (Say)* - COMMON BASKETTAIL* - rare (edge of range), near se border, West Hawk Lake 1-VII-1989 col. A.J. Mackay (1♀ J.B. Wallis collection); Star Lake 10-VII-1999 col. D.R. Collicutt and Lyons Lake 7-VII-2001 col. L. Barber (2♂ CDC collection).

E. spinigera (Selys) - SPINY BASKETTAIL - common, s and cent Man to Flin Flon.

Somatochlora albicincta (Burmeister) - RINGED EMERALD - status uncertain, recorded at Churchill, probably widespread in n Man.

S. cingulata (Selys) - LAKE EMERALD - status uncertain, recorded from Gillam and other points n, probably widespread in n Man.

S. ensigera Martin - PLAINS EMERALD - rare to uncommon, s Man, recorded at Lockport, Starbuck, McCreary, Onah, Westbourne and Brokenhead River.

S. forcipata (Scudder) - FORCIPATE EMERALD - status uncertain, recorded only from The Pas, probably occurs across n Man.

S. franklini (Selys) - DELICATE EMERALD - common, widespread in Man.

S. hudsonica (Hagen in Selys) - HUDSONIAN EMERALD - status uncertain, recorded from Norway House and Churchill, probably widespread in n Man.

S. kennedyi Walker - KENNEDY'S EMERALD - uncommon, recorded from Winnipeg n to Norway House.

S. minor Calvert in Harvey - OCELLATED EMERALD - status uncertain, recorded from s Man n to Gillam.

S. septentrionalis (Hagen) - MUSKEG EMERALD - status uncertain, a species of the far north, recorded from Churchill.

S. walshii (Scudder) - BRUSH-TIPPED EMERALD - rare to uncommon, recorded from Winnipeg, Star Lake and Dauphin, expected to occur n to tree line.

S. whitehousei Walker - WHITEHOUSE'S EMERALD - status uncertain, recorded at Churchill, probably widespread in n Man.

S. williamsoni Walker - WILLIAMSON'S EMERALD - rare, limited distribution in se Man, recorded from Winnipeg Beach, Gull Lake and Pinawa.

Williamsonia fletcheri Williamson - EBONY BOGHAUNTER - rare, se Man, recorded from "Lake Winnipeg" in 1890. [8] Rediscovered at Agassiz Prov. Forest 20 & 22-V-1980 col. T.D. Galloway (1♂1♀ J.B. Wallis Collection).

Skimmers (Family Libellulidae)

Leucorrhinia borealis Hagen - BOREAL WHITEFACE - fairly common, s Man n to The Pas.

L. frigida Hagen - FROSTED WHITEFACE - fairly common, se Man, s Interlake area.

L. glacialis Hagen - CRIMSON-RINGED WHITEFACE - fairly common, s. Man.

L. hudsonica (Selys) - HUDSONIAN WHITEFACE - common, widespread in all of Man.

L. intacta (Hagen) - DOT-TAILED WHITEFACE - common, s Man n to Dauphin.

L. patricia Walker - CANADA WHITEFACE - status uncertain, n Man recorded from Gillam and Churchill.

L. proxima Calvert - RED-WAISTED WHITEFACE - common throughout Man.

Libellula julia Uhler - CHALK-FRONTED CORPORAL - common, s Man n to Swan River.

L. luctuosa Burmeister* - WIDOW SKIMMER* - rare or accidental (edge of range), one record from n Winnipeg, 31-VII-1983 col. D. Pollock (1♂ J.B. Wallis Collection).

L. lydia Drury* - COMMON WHITETAIL* - (see Figure 1) - rare (edge of range), first record in Winnipeg in 2001 col. J.R. Duncan (1♂ in CDC collection). Additional records: Ste. Adolphe, 30-VI-2002 reported by Andy Courcelles; La Salle River at La Barriere Park,13-VIII-2002, col. M.L. Hughes (1♂ in CDC collection). Recent sightings indicate that it may be expanding its range into s Man.

L. pulchella Drury - TWELVE-SPOTTED SKIMMER - (see Figure 2) - common, s Man n to about 51°N.

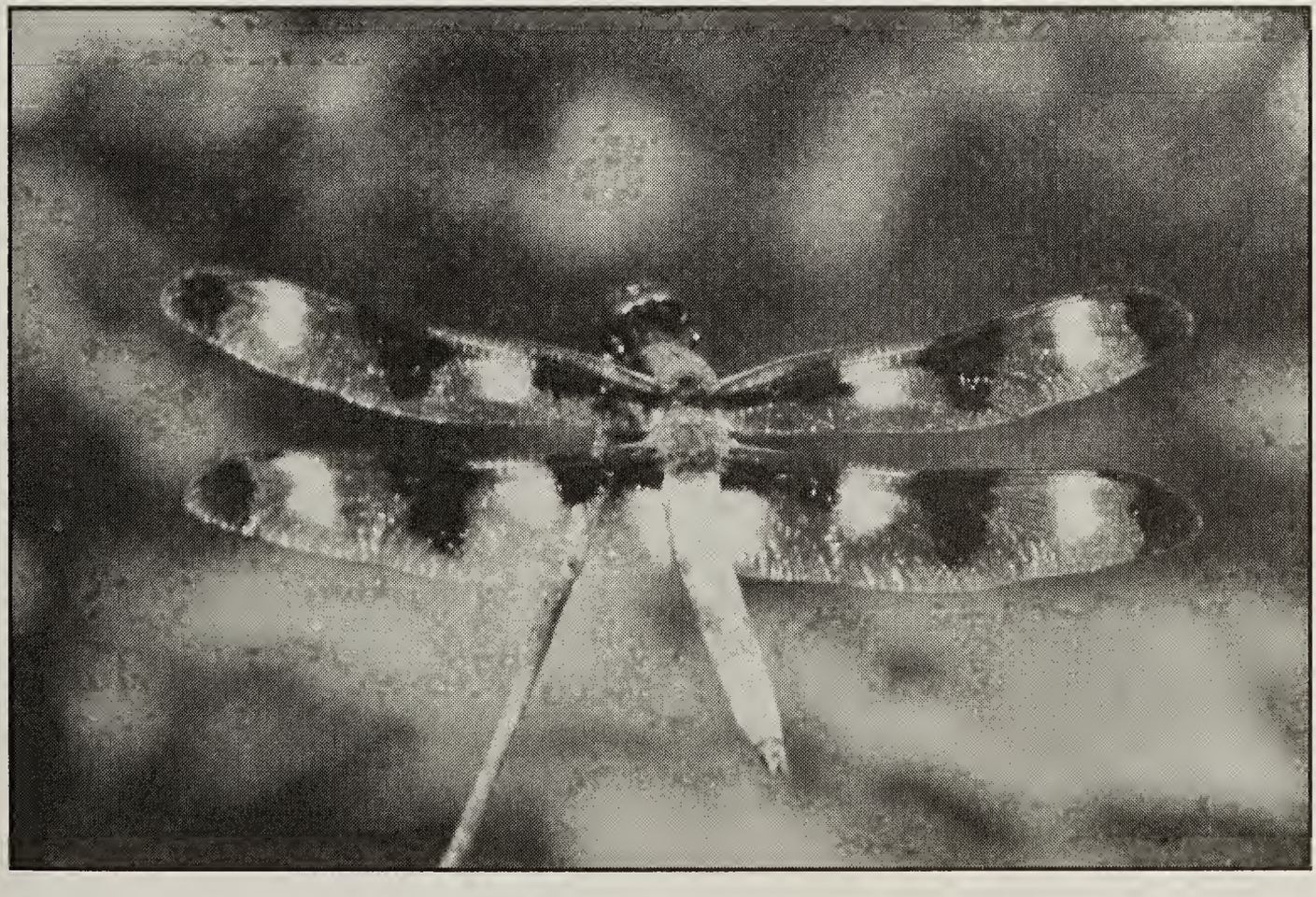

Figure 2. Twelve-Spotted Skimmer,* Libellula pulchella** ***David P. Hughes

L. quadrimaculata L. - FOUR-SPOTTED SKIMMER - common, s Man n to The Pas.

Pachydiplax longipennis (Burmeister) - BLUE DASHER - rare, one record from Lac du Bonnet.[8]

Pantala flavescens (Fabricius) - WANDERING GLIDER - rare, a migratory species, range includes s Man n to Gimli.

P. hymenaea (Say) - SPOT-WINGED GLIDER - rare, a migratory species, only two records, Gimli and Victoria Beach.

Sympetrum corruptum (Hagen) - VARIEGATED MEADOWHAWK - common, s Man to The Pas.

S. costiferum (Hagen) - SAFFRON WINGED MEADOWHAWK - common, s Man n to The Pas.

S. danae (Sulzer) - BLACK MEADOWHAWK - common, s Man n to Wabowden.

S. internum Montgomery - CHERRY-FACED MEADOWHAWK - common, s Man n to The Pas.

S. madidum (Hagen) - RED-VEINED MEADOWHAWK - rare, w Man n to about 54°N.

S. obtrusum (Hagen) - WHITE-FACED MEADOWHAWK - common, s Man n to The Pas.

S. semicinctum (Say)* - BAND-WINGED MEADOWHAWK* - rare (edge of range), s Man: Spirit Sands, Spruce Woods Prov. Park, 21-VIII-1999 (1♂) col. J.R. Duncan; Star Lake 2-IX-2001 (1♂) col. D.R. Collicutt; N.W.Angle Prov. Forest 28-VIII-2001 (1♀) col. C. Hamel and E. Reimer (all specimens in CDC collection).

S. vicinum (Hagen)* - YELLOW-LEGGED MEADOWHAWK* - rare (edge of range), se Man, Wallace Lake (Nopiming Prov.Park)12-VIII-2001 col. L. Pelletier (1♂1♀CDC collection).

Previous lists for Manitoba included the Green-striped Darner (*Aeshna verticalis*), Cardinal Meadowhawk (*Sympetrum illotum*) and Ruby Meadowhawk (*Sympetrum rubicundulum*). We have not been able to locate specimens to confirm these records and have concluded that they were reported erroneously. The Cardinal Meadowhawk is known in Canada only from British Columbia's south coast.[1,8] New research regarding the genus *Sympetrum* has made it easier to identify the difficult little red meadowhawks, including *Sympetrum rubicundulum*.[1] The reason for the previous report may be that the Ruby Meadowhawk is extremely difficult to distinguish from Cherry-faced and White-faced Meadowhawk unless the identifier is familiar with these species and has access to good references. Similarly, the Green-striped Darner is difficult to distinguish from the Canada Darner. The Green-striped Darner is known only from southern Ontario and the Maritime provinces.[7]

In many cases, species are rare in the province only because Manitoba is at the extreme edge of their natural range. Rarity in Manitoba is less of a concern for species common in their natural range outside the province. This applies to those noted above by the comment "edge of range". The Elegant Spreadwing and Cobra Clubtail, on the other hand, are at the edge of their natural range but are considered *uncommon* in other areas of Canada also. The record for the Blue Dasher is historic.[8] It is a southern species which reaches only the southern extremes of Canada and the Manitoba record may be an accidental occurrence. The Red-veined Meadowhawk is a western species with a few historical records from western Manitoba. It is fairly uncommon throughout its range. The Wandering Glider and Spot-winged Glider are migratory species which visit Manitoba occasionally but they cannot definitely be considered resident in the province. The Plains Forktail and Western Forktail are showing up in large numbers in

Alberta in gravel pits and other anthropogenic habitats. Manitoba studies of similar habitats are needed to determine the status of these species. The Pronghorn Clubtail is not common anywhere in Canada, hence closer monitoring of the Manitoba population is warranted. The Elusive Clubtail is common only on the Ottawa River and the population in Manitoba requires further study. Far too little is known of all the species of Striped Emeralds (the genus *Somatochlora*). This is due, in many cases, to their northern distribution and their association with northern lakes and peatlands. The Plains Emerald is known only from Midwestern states and provinces, and thus its rarity in Manitoba is of special concern. The Ebony Boghaunter is considered rare or uncommon in all provinces where it occurs (Manitoba to the Maritimes), but this may be due to its very secretive habits. Its bog habitat is common enough to consider it to be at little risk.

Acknowledgements

Funding for the study leading to this article was provided to the first author by the Dragonfly Assessment Project through Manitoba Conservation. This study could not have been completed without the participation of all those who have collected and submitted specimens to the Manitoba Dragonfly Survey, the J.B. Wallis Collection and the Manitoba Museum collection. Although some collectors are named in the text above, we owe thanks to all collectors because every contribution is important. Special thanks are owing to Terry Galloway for assisting with access to the J.B. Wallis Collection. Thanks also to Robert Nero for reviewing earlier drafts of this paper. Many thanks to David Hughes for allowing us to use his beautiful photographs of dragonflies.

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"A butterflier and a birder are linked in their love of flying creatures. Flying creatures, in turn, are linked by their ability to take to the air, a feat much admired in native cultures. The Ogala Lakota grouped flying creatures together, calling them 'Winged Peoples' and associated them all with the powers of the wind. Included in this group were birds, butterflies, moths and dragonflies – the latter venerated because of their ability to escape a blow."

- Joanne E. Lauck, *The Voice of the Infinite in the Small* p. 271

THE ROSE STEM GIRDLER (*Agrilus aurichalceus* Redtenbacher) (Insecta: Coleoptera: Buprestidae), A NEW THREAT TO PRAIRIE ROSES

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Since the summer of 1999 there has been a noticeable reduction in the wild rose (mainly *Rosa acicularis* Lindl. and *R. woodsii* Lindl. but also larger canes of *R. arkansana* Porter) bushes in the Maple Creek region of southwestern Saskatchewan. In 2000, some of the larger rose canes within stands were dead or died over the summer but such mortality did not seem unusual. However, in 2001 large areas of dead canes occurred in many stands and this expanded in 2002 so that entire stands were either dead or their leaves reddened prematurely in August and the stems died by early September. In 2000 I did not pay much attention to the dead stems other than to note that some of the dense patches seemed less impenetrable than they had been previously. However the significant increase in mortality in 2001 prompted me to examine the stems more carefully. On examination, it was found that almost every dead stem, somewhere along its length, had evidence of a spiral engraving under the bark in the surficial layer of the sapwood. These engravings were usually along the thicker parts of the stem from ground level to about mid-length with usually one spiral engraving per stem but some stems had several. The engravings were certainly the tunnels of an insect but the causative agent was not found and it could not be determined if the tunnel occurred before or after stem death.

In 2002, in an effort to determine what insect was tunneling in the stem, I examined rose bushes over the growing season for signs of damage and presence of possible causative insects, sweeping roses with a beating net to collect insects from the plants, and I also examined the bark and stripped the bark from stems that seemed moribund or showed leaf discoloration. Examination of the plants for insects and beating yielded a collection of typical insects associated with roses but also several specimens of a buprestid beetle (*Agrilus* sp.) were collected between mid-June and mid-July. Canes showing premature reddening and/or wilting of leaves were noted from late July into late August. Each of these canes had an insect larva tunneling under the bark and engraving the outer portion of the sapwood (Fig. 1). The tunnels were characteristic, following a helical path and forming several tight circles that effectively girdled the cane and presumably killed it as leaf discoloration and wilting occurred distal to the tunnel. The larvae removed from the tunnels were characteristic buprestid beetle larvae and presumably the larvae of the *Agrilus* species collected as adults from the foliage. The boring pattern was similar to that noted on dead canes the previous year. The beetle larvae were apparently tunneling in live canes and were the cause of the cane's death.

No native prairie species of *Agrilus* is known to feed on roses. However, Bright recorded *A. aurichalceus* Redtenbacher (the rose stem girdler) as occurring in Canada in southern Ontario and Quebec and in the

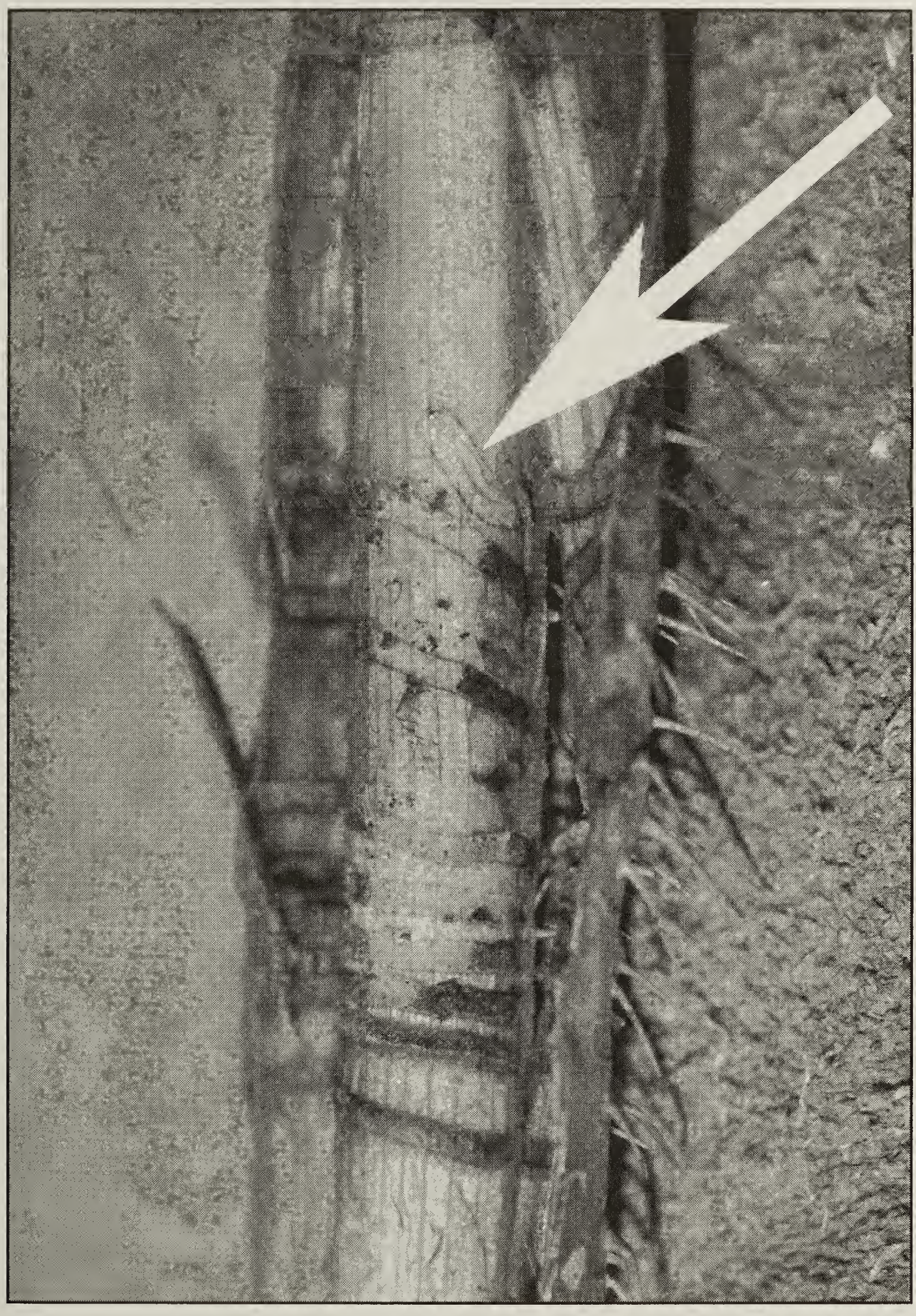

Fig. 1. Rose cane with bark removed to show spiral tunnel pattern of rose stem girdler* (Agrilus aurichalceus) *larva. The arrow points to a fully grown larva at the end of its tunnel.
David J. Larson

eastern United States west to Colorado.[1] The Saskatchewan specimens fit this species in both larval habits and adult morphology. This species is not native to North America but was introduced into New Jersey in 1923 and has subsequently increased its range in the eastern part of the continent, now to also include the southern part of the prairie provinces. Apparently it has recently spread into southwestern Saskatchewan.

The rose stem girdler is an economically important species known to kill roses as well as attacking species of *Ribes* (current) and *Rubus* (raspberry and blackberry). According to Bright, the female beetle lays its eggs into the bark of the cane, usually near the base of a leaf.[1] The larva bores into the sapwood and turns upwards as well as spiraling around the cane several times thus cutting the phloem and killing the cane. The mature larva bores into the pith of the cane, where it overwinters, then pupates the following spring with the adult beetle emerging in early summer. Although the larval burrows were easily found in Saskatchewan canes, I have not seen the overwintering or pupal tunnels in the pith and it is possible that, as an adaptation to the cold Saskatchewan winter, the larva might be leaving the cane and overwintering in the soil. There is one generation a year.

This beetle has the potential of greatly modifying the vegetational landscape of parts of the prairies. Roses form an important part of patches of bushes. Their dense, prickly stems exclude or reduce livestock grazing inside the patches and therefore they protect other plant species and maintain dense vegetation tangles that form important habitat for various types of wildlife. With the death of the roses, the patches become more open and easily accessible to both grazing animals and predators and the net result may be both opening up of such bush patches and possibly their loss. It is unlikely roses will be threatened as they persist as root stock and the beetle does not attack small canes, only canes of two or three years of age. As one rancher told me, "something strange is happening to the roses, they are blooming closer to the ground each year", an observation related to the fact the older and taller canes have died off and flowers are now produced only on the younger, shorter canes. It is likely that the prairies will end up with roses that are shorter and form patches with less dense, smaller stems.

Acknowledgements.
These observations were made while conducting research on insects of grassland pools, supported by a Natural Sciences and Engineering Research Council of Canada Discovery Grant. This note is offered as a contribution to the Grasslands Insect Project of the Biological Survey of Canada (Terrestrial Arthropods).

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"The rose represents love, magic, hope, and the mystery of life itself. Its name, ordinary enough, refers to its color (*rosa* is Latin for 'red'). But that's like saying the heart is a muscle situated on the left side of the rib cage. The flower's mysterious associations date to the earliest civilizations–the Persian word for rose, *gul*, also meant 'flower' and was close to *ghul*, the word for 'spirit.'"

- Diana Wells, *100 Flowers and How They Got Their Names*, p. 187.

PRAYING MANTIDS IN SASKATCHEWAN

RONALD R. HOOPER, Box 757, Fort Qu'Appelle, SK S0G 1S0

Until last year, no praying mantids had been recorded for the Prairie Provinces but, surprisingly, two were collected in Saskatchewan in 2002.

On August 13, in the west block of Grasslands National Park along a coulee that branches off the Frenchman River Valley, I swept a small brown praying mantis from Skunkbush (*Rhus aromatica*). This was about 2 km north of the Montana border.

The specimen was sent to Dr. Vernon Vickery, retired McGill University entomologist. He confirmed it to be the Minor Ground Mantis, *Litaneutria minor* (Scudder).[a] This is a species native to western North America, previously known to range north to southern British Columbia and northern Montana along the Milk River Valley just south of the Saskatchewan-Alberta border.[3] The Frenchman River drains southeastward into the Milk River, so I expect that this praying mantis naturally occurs where I found it and was previously missed by collectors.

The specimen is about 25mm long, a male with the wing covers (fore wings or tegmina) reaching to the end of the abdomen (Figure 1). It lacks the dark central blot usually present on the hind wing.

Amazingly, a second praying mantis was captured a few weeks later in Regina on September 9, 2002. It was on Brad Owen's window along Dewdney Avenue. He brought it alive to Jeanette Pepper at the

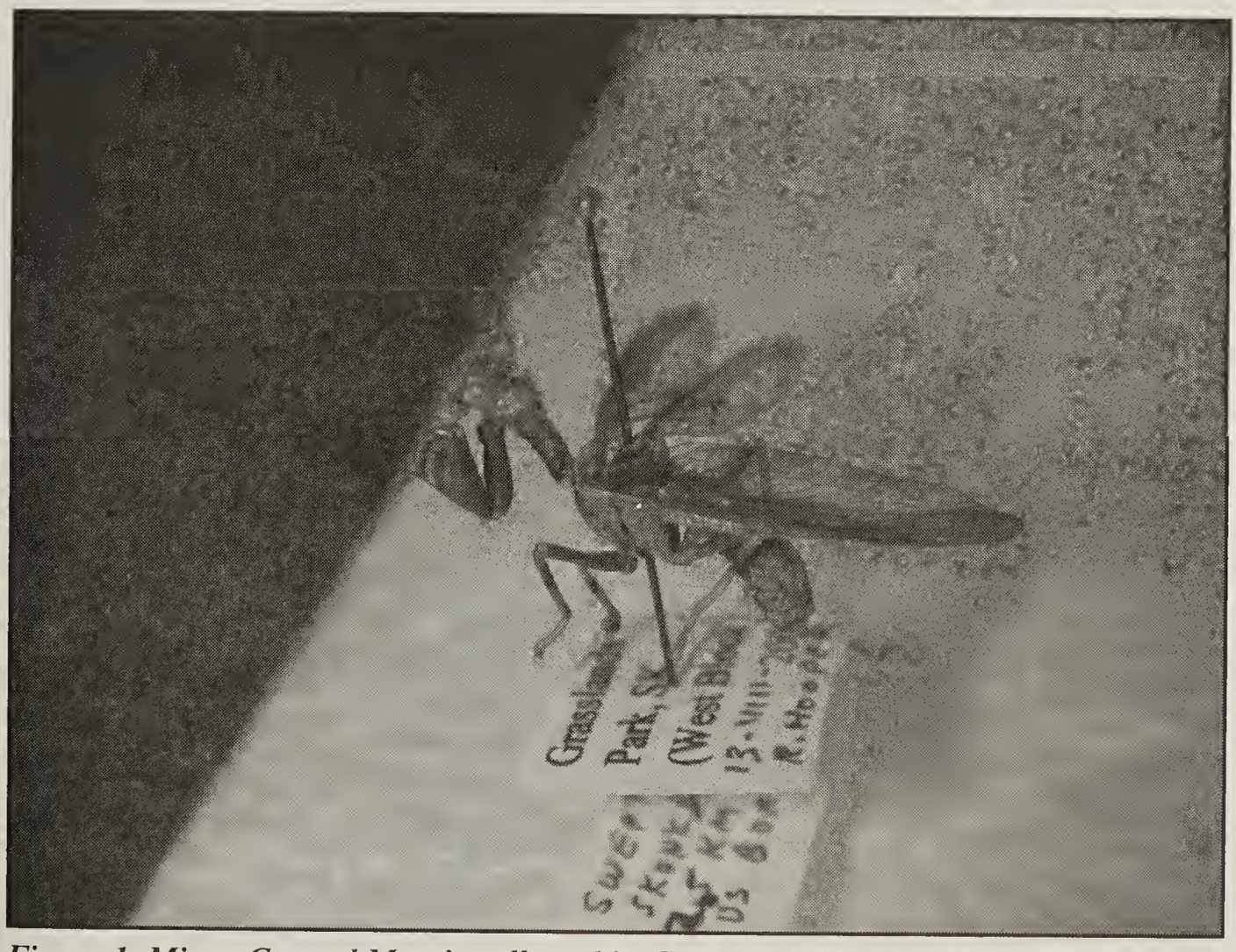

Figure 1. Minor Ground Mantis collected in Grasslands National Park in 2002
Jeanette Pepper

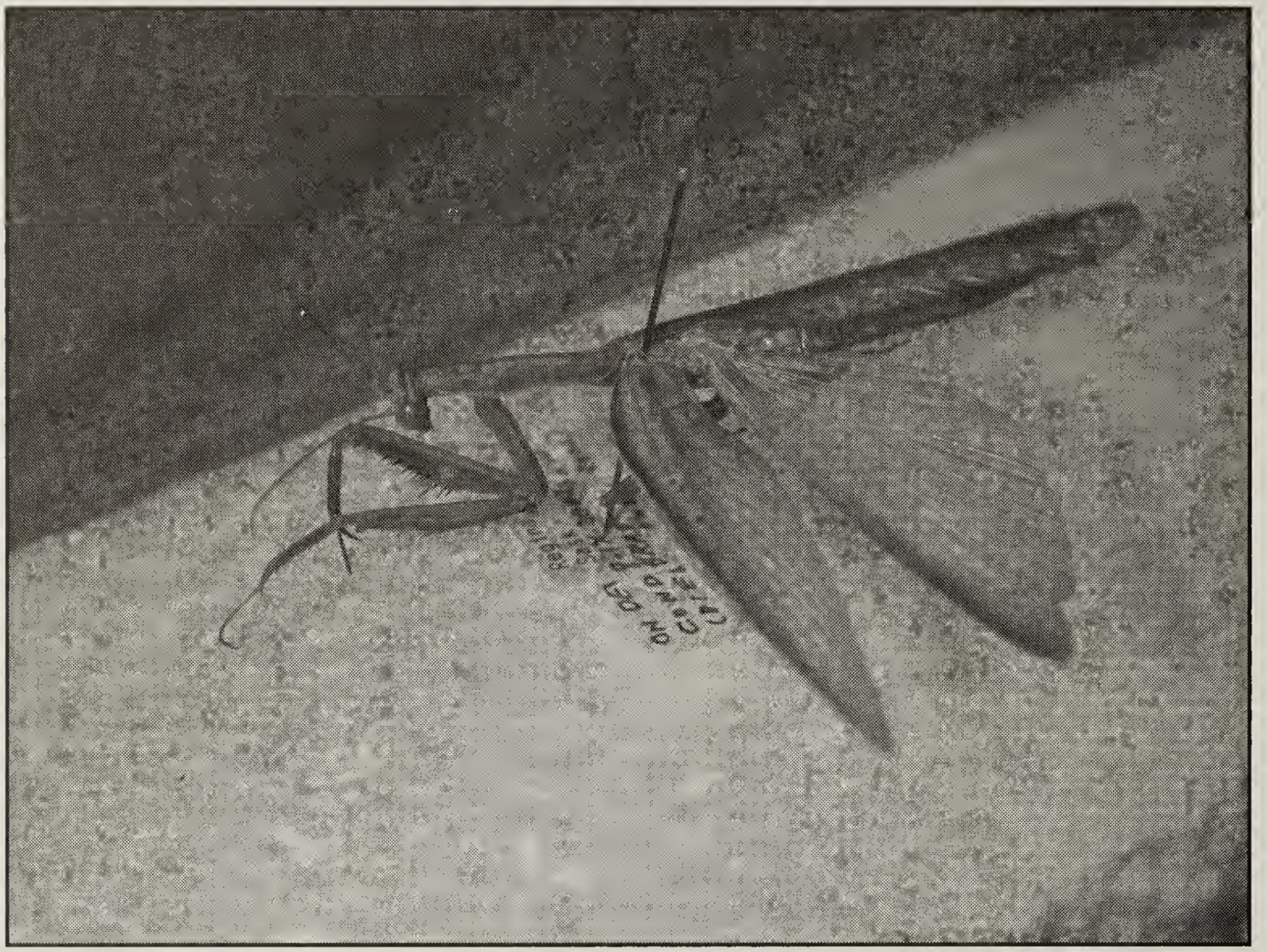

Figure 2. European Mantis collected in Regina in 2002 ***Jeanette Pepper***

Saskatchewan Conservation Data Centre. She mounted it and brought it to the Royal Saskatchewan Museum. This specimen is a brown colour phase of the European Mantis (*Mantis religiosa* Linnaeus) and is about 50 mm long (Figure 2).

The European Mantis ranges across Europe, Asia and North Africa, and was introduced accidentally into America.[1] It was first reported in 1899 at Rochester, N.Y. and is now widespread across temperate areas of the United States. In 1985, Vickery and Kevan reported it for Quebec, Ontario and Michigan, and also for the state of Washington and south-central British Columbia.[3] Perhaps our Saskatchewan specimen indicates that it may have spread north from the United States. On the other hand, it could possibly have blown into the province and therefore may not be established here at all. Another possibility is that it is an escaped pet. If anyone in the Regina area knows of a pet praying mantis escaping last year, we would like to hear about it.

Praying mantids have short, powerful front legs that they hold in a pious-looking fashion, as if they are praying. They are nature's example of a hypocrite, however, for they are not as pious as they look. As soon as another insect ventures within reach, the front legs extend quickly forward and grab the intruder for a meal. It then becomes a "preying mantis." The female praying mantis is no kinder to her mate: she may eat him during, or after, mating!

[a] Mantis common names, and the use of "mantids" as the plural of "mantis", follow Helfer 1963.

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NOTES AND LETTERS

BLUE PHASE ROSS'S GEESE AT GOVAN, SK

On April 22, 2003, the first day of my annual birdwatching trip to Central Saskatchewan, the primary objective was to see Whooping Cranes. Govan, my hometown, is my base of operations and the usual area of interest is within a 15 mile radius surrounding Govan. Whooping Cranes are to Govan as Canada Geese are to Wawa, Ontario; giant lobsters are to Shediac, New Brunswick; and Ukrainian Easter eggs are to Vegreville, Alberta. They are Govan's Big Thing. As I left Govan I waived to Walter, the three-times life-size Whooping Crane statue that presides over the eastern entrance to the town. About a week previously, six Whooping Cranes had been sighted and photographed near Fransher's Lake, about 10 miles to the northwest of Govan. While I have seen whoopers as late as May 6, whoopers are relatively early migrators and 2003 had good conditions for migration (good weather and south or south-easterly winds). As Whooping Cranes only stop for a few days, I had a sinking feeling that Walter might be my only whooper sighting, as it proved to be.

Just north of Govan, a large flock of white geese was feeding in a stubble field, in a low spot next to the railway adjacent to Highway 20. In the fall, large flocks of Ross's Geese come through the area but in the spring only a few attach themselves to the large flocks of Snow Geese. On the chance that there might be a Ross's Goose in the flock, I stopped opposite the geese. There was a good mixture of blue-phase and white-phase birds, tightly grouped. When I examined the flock with binoculars, the closest bird, (about 80 yards away) was a white Snow Goose but immediately behind it were two blue-phase midgets. They could only be blue-phase Ross's Geese.

While one of the little geese faced away from me, the other was full-face toward me. As pictured in National Geographic's *Birds of North America*, the belly was white although not quite as rounded; it had a half-inch blunt wedge pointed up the neck. The colour pattern was much different than the two patterns found on the blue-phase Snow Geese. Because the flock was so tightly packed, size comparisons were obvious but if there were more Ross's Geese (white or blue), I did not see them as they were eclipsed by the larger birds.

So, how rare are blue-phase Ross's Geese? While National Geographic describes Whooping Cranes as "endangered", blue-phase Ross's are the only birds described as "extremely rare." Kaufman states they are "quite rare." Hundreds of Ross's Geese are shot every year in the Govan area and no blue-phase ones have ever been noted.

- James L.W. McKay, 1135 - 3 Street N.W., Medicine Hat, AB T1A 7Y4

GLAUCOUS-WINGED GULL AT LAST MOUNTAIN LAKE NATIONAL WILDLIFE AREA

On April 23, 2003, I went to Last Mountain Lake National Wildlife Area (LMLNWA) at the north end of Last Mountain Lake. Over the years, one of the most productive places to see birds has been at the dam on the terminus of Lanigan Creek where it flows into an arm of the lake. The dam is located about a mile and a half east of LMLNWA headquarters and is reachable by a system of gravel and dirt roads. A small parking area is located about 200 yards from the dam, and if you wish to get closer to the dam, you are directed to walk.

Lanigan Creek is a spawning area for suckers and northern pike, and in years with water flowing over the dam, fish congregate downstream from the dam. The fish attract American White Pelicans, Double-crested Cormorants, Black-crowned Night-Herons, gulls and terns, and the odd rare birds such as a Cattle Egret.

This year when I reached the parking lot, there was a mob scene at the dam with hundreds of pelicans in the water and hundreds up on the bank as well as many cormorants and gulls. Eventually my binoculars came upon a large, strange gull amongst the swimming pelicans. The gull was feeding on something that was barely covered by the flowing water. The gull appeared light grey with no dark patches on its wings, body, tail or head. Occasionally the gull would rise, and from below, the wings had a marked two-tone effect with the flight feathers white and the front part of the wings slightly darker. The bird was too far away to note eye, beak or leg colour. None of the other gulls tried to steal what was obviously its prize food object.

I attempted a slow stalk to get a better look at the gull but my route was very exposed and, with the horde of birds present, there were a number of nervous ones. By the time I got close to the food object, the gull had disappeared. After consulting my bird books, I tentatively identified the gull as an immature Glaucous or Glaucous-winged gull.

My next visit to the dam was on May 2. Not much had changed except that there were far fewer pelicans and most were up on the bank. The water had receded but the big gull was still there eating at the same place. This time, my stalk was more successful. Even before I got to a point 60 feet from the bird, I determined that its eye was dark, that its beak was all dark and its legs were pink. The food was a very large fish about the colour and size of a large buffalo fish. My bird books indicated the gull was a first-year Glaucous-winged Gull, although the books show a washed-out pink leg colour while this bird was a definite pink. My books did not show a view from below of such a gull but two days later when I checked the new Sibley book, the two-tone effect that I had seen on April 23 was illustrated.[1]

Later in May, Phil Taylor of the Canadian Wildlife Service told me that he had seen the gull on May 6 and also concluded it was a first-year Glaucous-winged Gull. I visited the area several additional times in May, but never saw the bird again. The last time I visited, three California Gulls were still feeding on the large fish.

Glaucous-winged Gulls are birds of the

Pacific Coast. *Atlas of Saskatchewan Birds* lists four previous sightings, two of which were immatures.[2]

- *James L.W. McKay, 1135 - 3 Street N.W., Medicine Hat, AB T1A 7Y4*

1. SIBLEY, D.A. 2000. The Sibley Guide to Birds. Knopf, New York.

2. SMITH, A. R. 1996. Atlas of Saskatchewan Birds. Saskatchewan Natural History Society Special Publication No. 22. Regina.

THE POWER OF LIGHTNING

On July 8, 2002, a severe thunderstorm struck the South Saskatchewan River area north of Leader. The next day I photographed a Cottonwood tree on our ranch that had been struck by lightning. The tree was split down the centre from the branch forks to below the ground (Fig. 1). The force of the strike lifted chunks of sod around the tree roots (Fig. 2) and peeled long strips of bark off the trunk. This tree, which was in perfect condition before the storm, has a circumference of 9 feet at the base.

- *Daisy D. Meyers*, Box 218, Leader, SK S0N 1H0

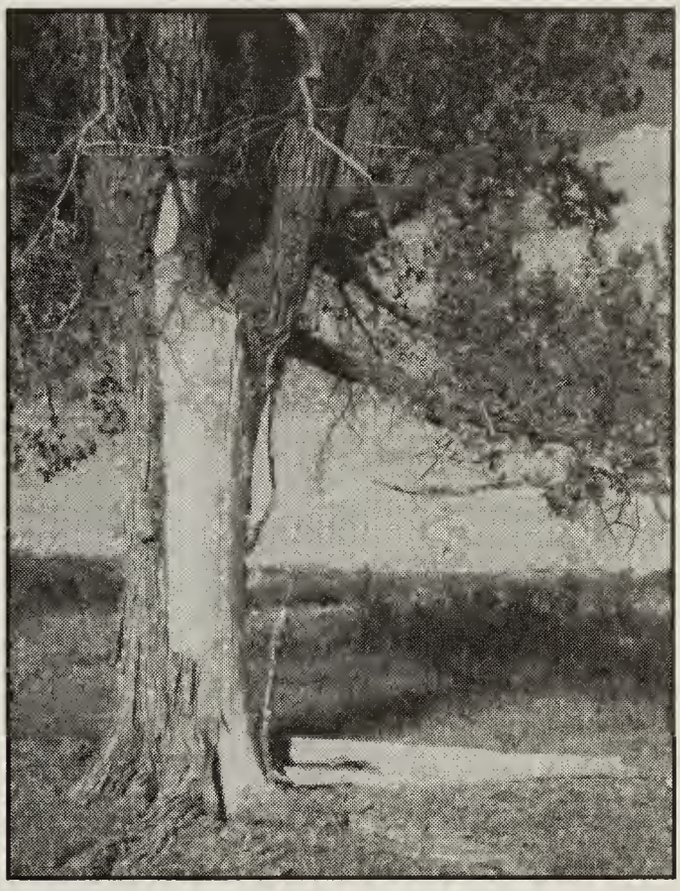


Figure 1. Tree trunk split by lightning strike ***Daisy Meyers***

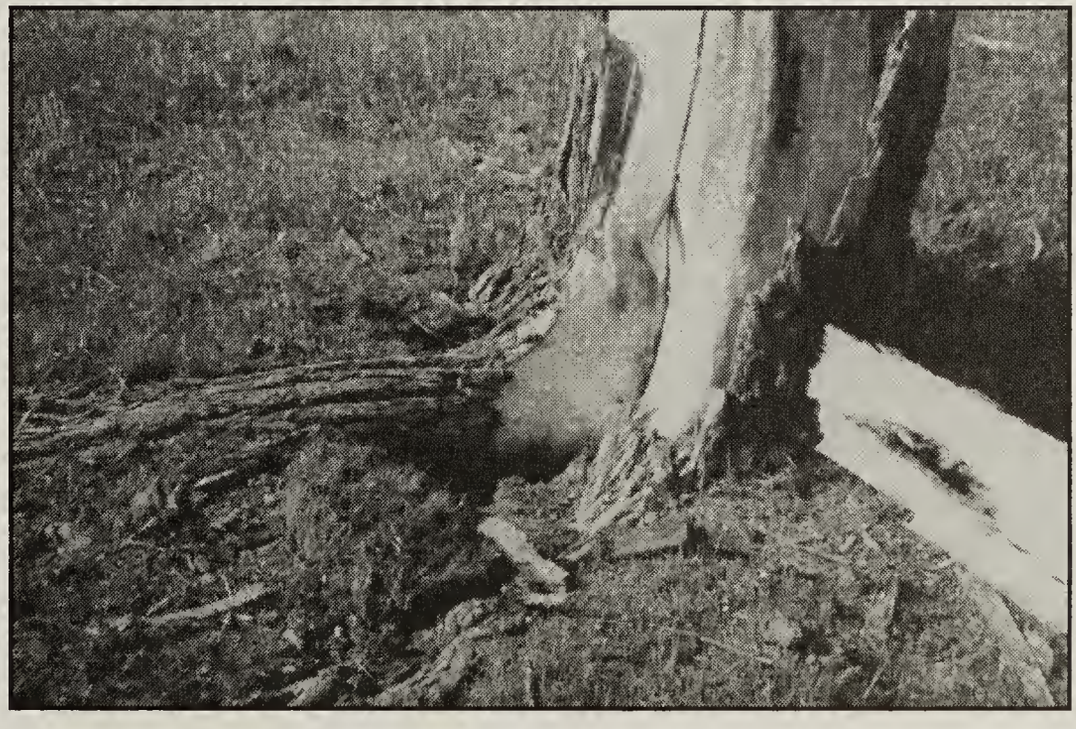


Figure 2. Sod disturbed at tree roots by lightning strike
Daisy Meyers

IN MEMORIUM

MARGARET BELCHER, 1920 - 2003

J. FRANK ROY, 650 Costigan Way, Saskatoon, SK S7J 3R2

Respected teacher, devoted member of Nature Saskatchewan from its inception in 1949, author, and mentor to dozens of budding naturalists, Margaret Belcher died in Regina, June 29, 2003.

Born at Dilke, SK, December 19, 1920, Margaret graduated from Luther College, Regina, received her B.A. from the University of Saskatchewan, an M.A. from the University of Toronto and continued post-graduate studies in France. For years she taught French at Regina College, where she was also Dean of Women. When Regina College became part of the new University of Regina, she taught in the French Department until her retirement in 1988.

Raised on a farm, Margaret loved the prairies and its people. Throughout her teaching career she maintained a home in Regina, but the family farm near Dilke was her retreat, to which she returned as often as she could and for a number of years, actually commuted from the farm to work. Until illness made a return to Regina necessary, Margaret lived in the farm home after retiring in 1988.

Margaret was a member of the executive of the Saskatchewan Natural History Society for 21 years, serving one term as president and 15 years as recording secretary. During those years she carried on the Society's extensive correspondence, marshalled background information to support the numerous resolutions passed at annual meetings, and helped prepare agendas for annual meetings with the provincial cabinet. Those of us who worked with her quickly recognized her quiet effectiveness. She was highly

organized, practical, persuasive, but never confrontational. In addition to her work on the executive, she was also associate editor of *Blue Jay* for 21 years. Never one to seek the limelight, Margaret was one of most outstanding contributors to the vitality and growth of the Saskatchewan Natural History Society in its first 50 years. Her contributions were recognized officially in 1989 when she was made a Fellow of the Society.

Despite her busy teaching career and the countless hours she devoted to the work of the Natural History Society, Margaret found time for her many friends and for community. One of her friends speaks for many: "Whenever I met her, she never failed to offer encouragement and support, not to mention solid, practical advice. Her friendly calmness of spirit invited confidence." She often led field trips for the Regina society, participated in the annual Christmas Bird Counts and, assisted by George Ledingham, conducted the Lumsden Breeding Bird Survey for 26 continuous years. She inspired many young people to develop an interest in nature and was a fond aunt to four nephews and a niece. She was always interested in farm life and a loyal supporter of the Saskatchewan Wheat Pool. She helped maintain St. Lucy's Anglican Church in Dilke and was actively involved in the local branch of the Red Cross. Her many contributions were recognized by the Regina Soroptomist Club which named her International Woman of the Year in 1988. In 1997 she was invested with the Saskatchewan Order of Merit and in 2003, a few weeks before her death, she received the Queen's Golden Jubilee Medal.

Margaret's *Birds of Regina* (1961), Special Publication No. 3, following Houston and Street's *Birds of the Saskatchewan River, Carlton to Cumberland* (1959), was the second annotated regional bird list published by the Saskatchewan Natural History Society. Illustrated with the sketches and photographs of Fred Lahrman, another distinguished member of the Society who, sadly, died the same day that Margaret did, *The Birds of Regina* established the pattern for the many regional publications that have followed it. A revised edition (Special Publication No. 12), significantly expanded, followed in 1980. In 1996 Margaret completed *The Isabel Priestly Legacy*, a history of the Saskatchewan Natural History Society, 1949-1990, and of its predecessor, the Yorkton Natural Society, founded by Isabel Priestly. Carefully researched, immensely readable, it ranks as a major historical document. In her introduction, Margaret admits the possibility that her long service on the executive (1954 to 1975) "has undoubtedly coloured my view of the Society's activities" but, she continues, "I have attempted to give a considered and objective view of events." Reading it, and knowing many of the personalities involved, I can only marvel at her objectivity and balance. Every member of the Society and anyone else interested in the ongoing struggle to preserve what is left of our natural heritage should read it. The title speaks of the Isabel Priestly legacy; the book confirms the continuation of that legacy in Margaret Belcher.

FRED W. LAHRMAN, 1921 - 2003

LORNE SCOTT, Box 995, Indian Head, SK S0G 2K0

- Photo courtesy of Regina Leader-Post

Fred Lahrman was born at Mortlach on September 4, 1921. He grew up on the family farm south of Mortlach in the Missouri Coteau with his sister, Louisa, and his brother, George. This home "out in the hills," as the coteau is referred to locally, provided Fred with the love and knowledge of the outdoors which was his life. Interestingly, the Missouri Coteau remains one of the most intact and productive ecosystems in southern Saskatchewan and the Lahrman family has turned over much of their native prairie land to the Saskatchewan Wildlife Federation and Ducks Unlimited.

Fred developed an interest in wildlife at an early age. His artistic talents were also evident when, as a small child, he would draw images of birds on the porch walls. At first his mother scolded him for this, but as she realized her son's talent, she encouraged him in his sketching.

In the 1940s, Fred moved to Regina to work and in 1946, he enrolled in the Balfour Technical School in Regina. He soon discovered the Natural History Museum which, at the time, was housed in the Normal School at College Avenue and Broad Street. Fred spent his spare time there sketching mounted birds and mammals. His artistic ability was noted by the museum's director, Fred Bard, who in 1947 hired him to do paintings for the museum exhibits.

For Saskatchewan's Diamond Jubilee celebration in 1955, the province chose a new museum building at College and Albert Street as one of their major projects. Working with Bob Symons, Fred designed, constructed and painted the diorama displays. The museum was ready on schedule and officially opened by Governor General Vincent Massey in 1955.

Fred worked for the museum from 1947 to 2002. Many of the original exhibits were destroyed in a fire in 1990 and were re-done after the fire. Fred completed the last one, on Last Mountain Lake, in 2002.

Fred's contribution to wildlife conservation extended beyond the museum. Drought in the 1930s and unregulated hunting had all but wiped out the Canada Goose in Saskatchewan. In 1952, he and Fred Bard obtained a pair of geese from Abernethy naturalist Ralph Stueck. They also obtained a few eggs from wild goose nests in the Cypress Hills and hatched them under domestic chickens. Fred often described the frantic hens pacing along the shoreline, squawking, when the goslings went swimming! By the mid-1950s, the first offspring of the captive geese were allowed to fly free around Wascana. News of the success with geese soon spread and there was a continent-wide demand for Canada Goose goslings from Wascana. In fact, goslings were shipped as far as Quebec, Florida, New Mexico and British Columbia.

Fred was also involved for over 50 years with Whooping Crane conservation. In 1953, he received the National Newspaper Award for one of his Whooping Crane photos and in 1955, a Whooping Crane stamp based on Fred's art was issued by Canada Post. Through continent-wide conservation efforts initiated by the two Freds, the Whooping Crane has made a remarkable recovery from 21 birds in 1941 to around 400 today.

Some of Fred's other activities were taxidermy, bird banding, setting up the first nature trails and interpretive displays in our provincial parks, and illustrating books. He was a generous supporter of the *Blue Jay*; he wrote or co-authored 43 articles, and provided 7 illustrations and 178 photographs to the magazine. These photographs showed 72 species of birds, 9 of mammals and 14 of insects. He also provided photographs, drawings and cover illustrations for several of Nature Saskatchewan's special publications.

Fred was an avid photographer, amassing thousands of colour slides of all aspects of nature; his photographs received awards and appeared in books and calendars. His first camera was a one dollar box camera, which he purchased in the 1930s.

Whereas some wildlife artists have chosen a career to market their paintings commercially, Fred chose to devote his life to public service at the museum. A number of years ago, Fred told me that the last thing he wanted was to be publicly recognized; he said he wanted to promote an understanding and appreciation of wildlife through art. The museum exhibits provide tens of thousands of people annually with the opportunity to see and enjoy nature. Fred said that what mattered to him was if some of these people were to go home and say, "I saw this at the museum and I am going to do something to help conserve wildlife."

One of Fred's major contributions was his untiring support, sharing of knowledge and patience with dozens of young people who came to work at the museum. He was always available and willing to answer questions and assist fellow employees.

Though relatively healthy throughout

his 81 years, Fred's health began to deteriorate in February of this year and he died on June 29. My last outing with him was on June 13 when we banded a nest full of young bluebirds. Fred held one of the young ones as he sat in the van. We also observed a nesting pair of Red-necked Grebes and Fred got to see Yellow Lady's-slippers in full bloom.

This humble and compassionate man has left us with cherished memories and a legacy that most of us can only dream about.

BILL HORSEMAN, 1942 - 2003

C. STUART HOUSTON, 863 University Drive, Saskatoon SK S7N 0J8

Bill Horseman holding a Goldeneye Duck, 1 June 1958.

Bill Horseman, born in Saltcoats on 21 January 1942, was a gifted lad: a good student, with unusual observational skills in the out-of-doors. While in grades 9 and 10 at Saltcoats he earned good pocket money on his trapline, skinning weasels and muskrats that he caught. Billy, as he then signed himself, at age fifteen, submitted an attractive black-and-white sketch of a Black-capped Chickadee to the Boys' and Girls' section of *Blue Jay*. When it appeared in the March 1958 issue, I phoned Bill. He told me of the Great Horned Owl nests he had found while on his trapline. On 19 May 1958, I picked up Bill and Don Swaby and we went to seven owl nests that day, banding 16 young.

Bill was a natural tree climber. Wearing flexible running-shoes and imitating the boys who climb tropical trees for coconuts, he placed the bottom of each foot in turn against the trunk and literally ran up the tree, particularly if there were no branches to impede him. My wife, Mary, watched Bill

climb partway up a tree, then climb across to the adjacent tree containing the owl nest. When she cautioned him about the possibility of trees breaking, Bill tried to relieve her worries by showing her how pliable aspen trees are in a wet year. He demonstrated this by climbing to the top of a twenty-foot aspen sapling, then leaning out to one side, so the tree bent like a bow, the top bending towards the ground, leaving him hanging about six feet above terra firma. Bill let go and dropped; the tree sprang upright. "See, Mrs. Houston, there is no danger of an aspen breaking."

With Bill as my chief nest-finder and tree climber, we banded an unprecedented one-day total of 40 owl nestlings in 17 nests on 17 May 1959. In the next two weeks we went to another six late nests found by Horseman, two nests found by farmers near Yorkton, and four nests north of Stornoway found by a new recruit, Stanley Zazelenchuk. That ran our second year's total up to 67 young in 29 nests. It was, in fact, Bill's efforts that launched my lifetime Great Horned Owl banding program.

Bill used his pocket money that year to attend the American Ornithologists' Union meeting in Regina, the first AOU meeting in western Canada. There he met Roger Tory Peterson, the author of his treasured field guide, as well as other teen-age birders including Spencer Sealy of Battleford, Glen Fox of Kindersley, Gary Anweiler of Melville, Ralph Ostoforoff of Kamsack and Frank Switzer of Rokeby.

Bill drove a long succession of 1951 Chevrolets. After he learned that this vintage vehicle had only one major flaw, he would offer cash on the spot to owners he met, checking first to see that the one weak component had not yet deteriorated. He proudly told me that he bought one such vehicle for $90, drove it for an additional 20,000 miles, and then sold it for $110, without spending a cent on repairs. Later, he kept an extra 1951 Chev handy to cannibalize for needed parts.

Bill kept his reprint of the "Birds of Yorkton", published in the *Canadian Field-Naturalist* in 1949. For the next fifty years, whenever he saw a species new to the Yorkton district, or something as noteworthy as the first nest of the Common Raven, he would phone me.

Bill died a tragic death on 19 June 2003. I treasure his memory; he was the greatest.

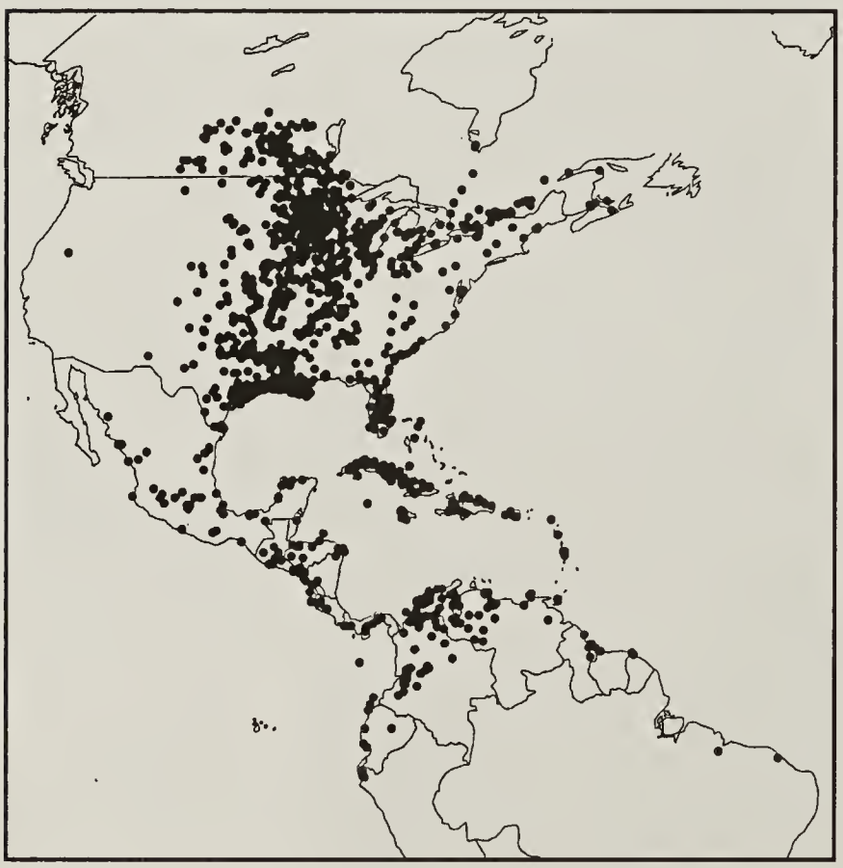
Bill Horseman, Stuart Houston and Great Horned Owl, May 1958

MYSTERY PHOTO

SEPTEMBER 2003 MYSTERY PHOTO

This object was found on a beach on the shore of the Beaufort Sea in the Northwest Territories but it could just as well have been found in Manitoba.. For its size (220 mm x 110 mm) it is remarkably heavy (1.4 kg or just over 3 lbs). A $1 coin is shown in the photograph by way of scale. What is this object?

ANSWER TO JUNE 2003 MYSTERY PHOTO



The map shows band recoveries from the Yorkton area. Only two species have been banded there in sufficient numbers to yield this large number of recoveries – Mallards (109,158) and Blue-winged Teal (105,852). Mallards from Yorkton do not go south of the Rio Grande, but the teal spread more widely than other waterfowl species, to blanket the Caribbean, Mexico, Central America, and northern South America to Peru and Brazil.

The editors would like to thank Stuart Houston for submitting the map and the answer for the June mystery photo.

CORRIGENDUM

Varied Thrush Winters at Melfort, June 2003, p127. The author of this note is Shirley Pannell, not Joyce Pannell as printed int the June issue. Please accept the editors' apology, Shirley.

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